THE GAS JOURNAL

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A Glance at the Contents—

Assistant Manager Required.

A Gas Company is inviting applications for the post of Assistant Manager. [p. 598.]

Gas Appliances—Arrangement and Ventilation.

This was the subject of a paper by Mr. A. Tyler, Sanitary Inspector to the City of London, in a paper read before the Sanitary Inspectors' Association Annual Conference at Colwyn Bay on Sept. 7 last. [p. 592.]

North British Association Meeting.

The Seventy-First Annual General Meeting of the North British Association of Gas Managers was held in the Town Hall, Ayr, on Thursday, Sept. 8, and was largely attended, over 200 members and friends being present. [p. 567.]

New Technique of Heat Transfer.

We have received from the University of Michigan a copy of a Bulletin which gives an account of research into the use of diphenyl vapour for heating asphalt. Though this application may not in itself be of first interest to our readers, our account of the use of diphenyl vapour as a heating agent is worthy of attention and may prove suggestive in regard to other channels. [p. 588.]

Association of Public Lighting Engineers.

Our report of the proceedings at the annual conference in Blackpool commences on p. 589.

Relation of C.V. to Working Results.

In a paper before the North British Association of Gas Managers, Mr. James Jamieson, of Edinburgh, suggests that gas of a calorific value of 450 B.Th.U. would be the ideal when carbonizing average Scottish coal. [p. 573.]

Naphthalene Removal and Benzole Recovery.

A procedure is outlined which should enable the benzole scrubber itself to function as a highly efficient naphthalene washer, with the result that the installation and operation of a naphthalene scrubber would be avoided. [p. 566.]

Presidential Address of Mr. T. W. Harper.

In his Presidential Address before the North British Association of Gas Managers on Sept. 8, Mr. T. W. Harper gave an outline of the progress of the Ayr Gas Company, with special reference to the last fourteen years, during which period he has been in charge of the Undertaking. [p. 567.]

Forthcoming Engagements

Sept. 15.—S.B.G.I.—Meeting of Council in the afternoon.

Sept. 19.—INSTITUTION OF GAS ENGINEERS.—Meetings of Calorimeters Sub-Committee, 2.30 p.m.; Sir Arthur Duckham Memorial Fund Exploratory Committee, 4.30 p.m., 28, Grosvenor Gardens, S.W. 1.

Sept. 20.—INSTITUTION OF GAS ENGINEERS.—Meetings of Joint Research Committee, 10 a.m.; Liquor Effluents and Ammonia Sub-Committee, 2.30 p.m., 28, Grosvenor Gardens, S.W. 1.

Sept. 21.—INSTITUTION OF GAS ENGINEERS.—Meetings of Meters Committee, 10.15 a.m.; Tar Sub-Committee, 12 noon; Committee on the Admittance of Chemists to Corporate Membership, 2.30 p.m., 28, Grosvenor Gardens, S.W.1.

Sept. 22.—WALES AND MONMOUTHSHIRE ASSOCIATION.—Meeting at Porthcawl.

Sept. 26 to 28.—B.C.G.A.—Annual Conference at Leeds.

Sept. 30.—INSTITUTION OF GAS ENGINEERS.—Meeting of General Research Committee, 2.30 p.m., 28, Grosvenor Gardens, S.W. 1.

Oct. 4.—INSTITUTION OF GAS ENGINEERS.—Meeting of Sir Arthur Duckham Memorial Fund Committee, 3 p.m., 28, Grosvenor Gardens, S.W. 1.

Oct. 7.—NORTH OF ENGLAND ASSOCIATION.—Autumn Meeting.

Oct. 10.—INSTITUTION OF GAS ENGINEERS.—Meetings of Finance Sub-Committee, 2 p.m.; Finance Committee, 2.30 p.m.; Executive Committee, 3 p.m.; Benevolent Fund Committee of Management, 4.30 p.m., 28, Grosvenor Gardens, S.W. 1.

Oct. 11.—INSTITUTION OF GAS ENGINEERS.—Meetings of Council, 10 a.m.; Board of Examiners, 12.15 p.m.; Gas Education Committee, 4 p.m., 28, Grosvenor Gardens, S.W. 1.

Oct. 13.—INSTITUTION OF GAS ENGINEERS.—Meetings of Joint Lighting Committee, 11 a.m.; Gas Appliances Sub-Committee, 2.30 p.m., 28, Grosvenor Gardens, S.W. 1.

Oct. 20.—INSTITUTION OF GAS ENGINEERS.—Meetings of Refractory Materials Joint Sub-Committee, 11 a.m.; Pipes Sub-Committee, 2.30 p.m., 28, Grosvenor Gardens, S.W. 1.

EDITORIAL NOTES

Gas and Coke Makers

THE Annual Meeting of the North British Association of Gas Managers—one of the chief yearly attractions for gas engineers north of the Border—took place last week. Under the Presidency of Mr. T. W. Harper, of Ayr, the meeting was held appropriately enough within a few miles of Lugar, where, in the Old Bello Mill, William Murdoch made his first experiments on the production of illuminating gas from coal. In all respects the gathering may be counted highly successful, from the several points of view of the numbers attending, hospitality and cordiality, and the interest and standard of the technical programme. The meeting will, in fact, be remembered with both pleasure and profit. In his Address as President, Mr. Harper outlined the development of the Ayr Gas Undertaking, for the progress of which he has been responsible since 1918. And a thoroughly praiseworthy record he has to relate—a 65 p.ct. increase in gas sales during the past fourteen years, with an increase of only 360 in the number of consumers, for Ayr is a residential town. Consumption per consumer, as we have long maintained, is a true index of progress; and the fact that since 1918 the figure for the Ayr Gas Company is a matter of 74 p.ct. increase needs no further comment.

One feature of Mr. Harper's Address appeals to us very strongly—his clear, and we believe correct, outlook on the business of the gas engineer. Carbonization yields primarily two very important smokeless fuels—gas and coke. And the only idea which will spell rapid and sustained progress for the Gas Industry is an appreciation of the part which coke can play (but which in many cases at present it does not) in cheapening the gaseous therm. It is axiomatic that on the yield from what are so loosely termed " residuals " depends the price which the consumer has to pay for his gas; and it ought, we suggest, to be more fully realized that good gas coke, properly sized and of uniform composition, is a wonderful selling proposition. To concentrate solely on gas manufacture is, to our mind, a mistaken conception for the gas engineer. There ought to be a well-reasoned compromise of gas *and* coke manufacture. To gain an extra therm or so of gas at the expense of a high-quality coke suitable for domestic purposes is a mistaken policy. Those few added gaseous therms may quite easily defeat the underlying purpose of gas-making—cheap gas at the consumers' premises. There is a field for gas coke—a field of vast opportunity. Already public opinion is favouring the " smokeless city," but it is unreasonable to think that the householder will " stand for " supplies of coke which at one moment are soused with water, and at the next contain an unworkable amount of ash; which at one moment are dense and hard, and at the next are porous and bulky. " Dumping " is partially responsible for this state of affairs, but so also is the way in which gas manufacture is carried out.

This criticism is not destructive. By all means let us use every endeavour to increase the efficiency of gas production—the cost of the therm into the holder *and out of it;* but do let us preserve at the same time a sense of proportion regarding the coke market and its effect as the most powerful ally to gas sales. It is folly to deny that at present we do not pay half as much attention to coke sales as we ought to pay. Mr. Harper is on the right lines. " In past years," he says, " the hunt for increased yields of gas per ton of coal, while very desirable, has in some cases reduced the quality of coke, but this is a fault which might quite easily be overcome by a better selection and blending of coal. Too often, I think, the desire has been to obtain a low average price of coal with the result that the quality of residual coke, irrespective of the gas produced, has not been all that might be desired. It has been my experience during past years to watch carefully the class of coal which gives a good yield of gas and at the same time a good and useful quality of coke suitable for the requirements of the domestic consumer. To obtain this I have reduced to a low figure the number of different coals, which will give that particular blend and a good quality of smokeless fuel, and I am of the opinion that what is being done to-day in some large undertakings in the production of smokeless fuel can be accomplished by the whole of the Gas Industry. . . . There is one outstanding point to be remembered, which is that there would likely be a slight handicap in the efforts for high yields of gas per unit of coal caused by attempts to produce a better class of coke. While this might at first seem to indicate a reduction in the return for gas produced it would eventually be counterbalanced by an enhanced value returned for coke, so that in the end we should be no worse off." Our feeling is that we should be very much better off.

The Cheapest Therm

THE subject of the production of the cheapest gaseous therm is one which has always been of first interest to the gas engineer, and must ever make fresh appeal; and a comprehensive paper by Mr. James Jamieson, of the Edinburgh Corporation Gas Department, before the North British Association of Gas Managers provides a wealth of figures on the production of gas of various grades in Woodall-Duckham continuous vertical retorts. The author and his staff have obviously devoted an enormous amount of painstaking work to the preparation of the paper, which will be a source of reference for all engineers operating vertical retorts, and whose thanks on this score Mr. Jamieson well merits. Divided into three sections, the paper discusses in turn the present position of gas supply in regard to declared calorific value, the production of 500 B.Th.U. gas in continuous verticals; and, finally, the production of various qualities of gas ranging from 500 to 400 B.Th.U. per c.ft. As to the present position, only 3·8 p.ct. of the therms supplied by authorized undertakings in Great Britain are in gas of a calorific value of less than 440 B.Th.U., while over 43 p.ct. is associated with 500 B.Th.U. The tendency of recent years has, indeed—as was so clearly pointed out by Mr. W. J. A. Butterfield in the " JOURNAL " for March 2 last—been towards the narrow range 475-500 B.Th.U.

Why, asks Mr. Jamieson, this rigid adherence to higher declarations? And he proceeds to an exhaustive analysis of the published figures of works making gas of 400, 425, 450, 475, and 500 B.Th.U., in the process becoming impressed by the bewildering variation in the results of therms made per ton of coal carbonized, coke and tar available for sale, and so on—a variation which seems to know no law of logic. However, in the first part of his paper he arrives at these conclusions: That undertakings having a declared value of 475-500 B.Th.U. show a favourable " net cost of gas into holder; " that statistics can easily be misleading; and that high yields of gaseous therms per ton are not by any means necessarily the most profitable. The figures he quotes in this section are certainly not adverse to the production of gas of 475-500 B.Th.U., and his expressed opinions as the result of his analysis are at variance with his advocacy of 450 B.Th.U. gas at the conclusion of his paper. Mr. Jamieson concludes the first section of his paper thus: " I do seriously suggest that no case can be made out from them [*i.e.*, the

returns he sets out] for the general adoption of gas below 450 B.Th.U., and maintain that, with efficient management and plant, reasonably high-quality gas can be produced as cheaply as low-grade gas, and the carrying capacity of the distribution system thereby advantaged."

500 Gas from Verticals

THE second section of the paper is a full account of carbonizing development at the Granton Gas-Works—the transition from inclined retorts to Woodall-Duckham continuous verticals, the installation of a full-scale test plant, and its virtues, and how, after more than a little skill and experiment it became a comparatively simple matter to produce efficiently in continuous verticals gas of 500 B.Th.U. per c.ft. from average Scotch coal, the supply meeting at all times the most stringent conditions laid down by the Gas Regulation Act. In this regard the author has much to say on coal sizes, rodding of the charge, and gaseous thermal yield per ton of coal carbonized—practical observations which are sure to be of value to all gas engineers. His keenness on a high thermal yield per ton is apparent. "Striving for the maximum thermal production in any particular declaration has its compensations," he observes, "but this is more marked when the declared value is in the region of the limit possible with the coals available, as the plant must be maintained and operated at the highest standard of efficiency, and on this account I have no doubt losses which might otherwise have remained unobserved have been discovered and rectified with beneficial and improved results." This, of course, is a good point; but equally important to our mind—and it is a phase of efficient carbonization which the author does not emphasize in the least—is throughput of coal per retort per day, for on this factor largely depends economical gas production. A high yield of gaseous therms per ton of coal does not, in fact, give anything like a true picture of whether a carbonizing plant—be it the horizontal or the vertical system—is being utilized to the best advantage.

Turning now to one or two of the purely practical points of plant operation, of which there are many in the paper under review, we are glad to have Mr. Jamieson's testimony to the efficiency of employing high temperatures in the combustion flues, for too little boldness is displayed in this direction. The following quotation is important, and we agree with its substance: "I have come to the conclusion that it pays to employ high temperatures, and I am convinced that when high-class refractories are used high heats are little if any more detrimental than lower heats; indeed, from observation I have made over a long period I have come to the conclusion that refractories suffer more from variations than through high heats constantly applied." Then the author's comments on coal and coke conveyors and on the relative merits of recuperative and non-recuperative settings of continuous vertical retorts are full of interest. He puts forward the figures for net fuel consumption of 8·3 p.ct. on the weight of coal charged in the recuperative setting, and 4·7 p.ct. in the non-recuperative setting. This large reduction is accounted for by the fact that the brickwork in the non-recuperative settings, including producers, amounts to only 80 p.ct. of the volume of brickwork in recuperative settings, and by the fact that the waste gases enter the waste-heat boiler of the non-recuperative setting at a higher temperature, with the result that the amount of steam generated per ton of coal carbonized increases from 900 lbs. with recuperative settings to 1710 lbs. with non-recuperative settings. A further advantage stated is that the non-recuperative settings give a lower pressure loss through the system, thus reducing to a minimum pressure differentials between the combustion flues and the retorts and saving fan power at the inlet of the waste-heat boilers. Mr. Jamieson puts forward the advantages of the battery type producers over a number of individual producers—no retort is dependent on the condition of a particular fire; a producer in the battery may be let down without any interference to the working of the setting; producer gas enters the setting almost free from dust; steady heats can be maintained throughout the whole installation.

450 B.Th.U. Gas

IN regard to the production of various qualities of gas, which subject constitutes the third section of Mr. Jamieson's paper, the author has carried out a comprehensive series of tests, full details of which he gives. The conclusion he arrives at is that, at the coke and tar prices ruling, with average Scotch coal the most economical quality of gas from a production point of view is in the region of 450 B.Th.U. per c.ft. "A change in the price of coal, a drop in the value of coke or tar, would immediately alter the position; but from whatever angle I have approached the subject I have been impressed with the consistency of the results and costs following the middle range of quality—so much so that I consider it would make an efficient and ideal standard declaration for Scotland whether gas is produced in verticals or by the two-stage process." Mr. Jamieson arrives at this advocacy of 450 B.Th.U. gas because of the fall in the market price of coke, and the increase in the market price of tar, but we do not share the author's pessimistic view that low coke prices are to be regarded as permanent. We have faith that modern marketing of a satisfactory smokeless domestic fuel produced by high-temperature carbonization is capable of transforming the present sales of gas coke. By modern marketing we imply the same "service aim," including service after sales, which is now the established policy of gas selling, and we imply also up-to-date propaganda work in all its various phases. And though we do not lose sight of the fact that Mr. Jamieson concerns himself only with production costs of the therm, we are not at all satisfied that the lowest production cost is sufficient justification for advocating that gas of a certain quality should be made. Our idea is that the only true basis is the cost of the therm at the consumers' burners. This is the criterion on which the gas-making plant should work. If, for example, the cost of the therm of 500 B.Th.U. gas into holder were half as much as the cost of a therm of 450 B.Th.U. gas, it would still pay to make gas of the latter declared value if there was a margin in favour of the final cost of this gas at the consumers' burners, compared with the final cost of the 500 gas. And *vice versâ*.

The Blackpool Conference

MANY things must strike a visitor on making his first acquaintance with Blackpool, and all of them, it may be said, testify to the progressive lines upon which the town is run. Some of the points that attract attention may be small in themselves, but others are very big indeed, and taken as a whole they convey an overwhelming impression of enterprising and far-seeing administration. It is evident that the authorities and those in business there are not afraid to adventure outlay where outlay is likely to prove profitable; and this policy meets with its inevitable reward. In no case is it truer than of a seaside resort that "money gets money." Blackpool has gone so far even as to deny the application of its own name; for instead of being "black," it breathes the very spirit of brightness. Thus it was an eminently suitable place for the holding of such a conference as assembled there last week to discuss problems in connection with public lighting. It must not, however, be said that the attractions of Blackpool were responsible for the fact that there was a record attendance. The real reason for the growing size of the meetings of the Association of Public Lighting Engineers is to be found in increasing recognition of the vital importance of all that the Association stands for, and in the enthusiasm of the members.

It was, perhaps, inevitable that the question of economy should crop up, and it is also well that it should have done so, for opportunity was afforded of clearing away a little confusion of thought. Words, alas, like clothes, have a vogue; and one must admit that in this way the word "economy" has at times been used with disregard of its application to the case in point—a disregard which sometimes places it on the wrong side of an argument. In connection with public lighting, for instance, true economy lies with an installation adequate to

every requirement. Lighting that is good enough to save lives and to prevent crime is just the sort of economy that is needed. Semi-darkness which may cause the loss of valuable human lives and encourage crime is a gross extravagance which the country should not for a moment tolerate.

It has to be remembered, too, that frequently public lighting may be improved, in the direction of being brought up to date, without a great additional outlay (if any) on running costs being incurred. The public lighting engineer may be able even to point the way to a direct monetary saving, while still providing that standard of outside illumination which to-day is desired, and to-morrow will be demanded. Be that as it may, however, there must be progress in public lighting. The time has passed by for such a condition of things as was reported a few days back in the "Evening Standard," whose correspondent in Hampshire wrote that the decision of the Alton Urban District Council not to start lighting the streets until Sept. 17 had aroused protest. The Council had also decided to cut off four all-night lamps altogether, on the ground of economy. A motorist said: "When I leave Farnham, where the lamps are lighted, I have to travel to Winchester, a distance of 26 miles, before meeting the first lighted street lamps. If that is not asking for trouble from bandits, what is?" Such a state of affairs is not the lesson to be learned from the Blackpool conference.

The "JOURNAL" pages afford ample evidence of the success of the meeting from the points of view both of papers and debate. Public lighting engineers have done much good work, and one can see that much more equally good work lies before them. If opportunity be really a fine thing, then those responsible for the lighting of the country's thoroughfares are to be envied; for they have it in plenty.

Correspondence

Sampling of Coal.

SIR,—May I be permitted to refer to Dr. Grumell's letter on the above subject in your issue of Aug. 31?

I quite support Dr. Grumell's contention that my paper published in the "Journal of the Institute of Fuel" referred only to one specific method of sampling in the B.S.I. Specification, and I had no intention, and do not wish any of the Technical Press, to interpret into my paper a general condemnation of the whole of the B.S.I. Specification.

The paper in question dealt *only* with the *sampling of dry slacks from the tops of wagons.* The specification includes a method of sampling from the tops of wagons, and despite the statement that samples should be taken wherever possible from a moving stream of coal, the very inclusion of the former method suggests that it is reliable. Our investigations go to show that considerable doubt is thrown on its general reliability due to segregation occurring during the filling of the wagons. A sample consisting of increments taken in the manner recommended will not necessarily contain representative proportions of fines and coarse material, and if the ash contents of the various sizes differ, which is often the case, the bulk sample will differ in fines and ash content from a truly representative sample. It is not suggested that this will always occur, since it is dependent upon the amount of segregation taking place. If, however, pronounced segregation occurs, the reliability of the sample will obviously be in doubt.

It is suggested that if anyone intends to use the method given in the B.S.I. Specification for sampling from the tops of wagons, tests should be performed on the particular fuel in question by sampling from the tops of the wagons and also during filling or discharge to ascertain what differences are likely to be met with. The difference will depend on the particular slack, the method of filling the wagons, the segregation occurring, and the settling during transit if sampled subsequently.

Yours, &c.,

N. SIMPKIN.

Lancashire and Cheshire Coal Research Association,
7, Park Street, Cheetham,
Manchester,
Sept. 8, 1932.

PERSONAL

Dr. HAROLD MOORE, C.B.E., who has for many years been Director of Metallurgical Research at the Research Department, Woolwich, has been appointed as from Oct. 1, 1932, Director of the Research Association, to succeed Dr. R. S. HUTTON, who has been elected to the new Goldsmiths Professorship of Metallurgy at Cambridge University.

OBITUARY

At the funeral of the late Mr. E. G. SMITHARD, formerly Engineer of the King's Lynn Gas Company, the Eastern Counties Gas Managers' Association was represented by the President, Mr. P. D. Walmsley, of Yarmouth; the late Secretary, Mr. E. F. Keable, of Gorleston; Mr. P. Colyer, of Cromer; Mr. W. C. Church, of Chelmsford; Mr. L. Williams, of Thetford; and Mr. W. C. Chapman, of Boston, Hon. Secretary and Treasurer.

"Planning of Gas Installations to Conform with the British Standard Specification for Street Lighting."

The Joint Lighting Committee of the Institution of Gas Engineers has published a scientific Paper of outstanding importance to everyone concerned with Street Lighting. Written by Mr. F. C. Smith, Assoc.M.Inst.Gas E., it is the result of several months' work on the district and in the Watson House Research Laboratories of the Gas Light and Coke Company, the Governor and Court of Directors of which kindly gave permission for the investigation to be undertaken, in response to the invitation of the Institution.

"The Planning of Gas Installations to Conform with the British Standard Specification for Street Lighting" outlines a method of deciding the type of lamp and orientation of light sources to be employed, while methods are suggested of obtaining the additional information required to be submitted with the tenders. Of this information the most important is the light distribution of the sources employed and the distribution of illumination on the road which would result from their use.

In Appendix (1) will be found the results of a number of tests on typical gas lamps carried out in the Watson House Laboratories of the Gas Light and Coke Company, together with the results obtained with two new reflectors specially evolved during the work.

Appendix (2) contains a series of curves, plotted from simple formulæ (page 58), which enable the candle-power required, and the angles at which it must be directed, to be read off for any particular arrangement of the lamps.

Appendix (3) consists of a number of street lighting schemes which have been produced by applying the method outlined in the Paper to the information contained in appendices (1) and (2). These would afford practicable methods of lighting streets 30, 40, or 50 ft. wide to levels of illumination represented by Classes C to H of the British Standard Specification for Street Lighting. In addition some information regarding the demonstration Class A Lighting in Whitehall in 1931 is given.

Appendix (4) contains a suggested basis for prescribing the class of illumination necessary for a given type of thoroughfare, and shows in what degree the gas lighting of certain well-known London streets conforms with this basis.

The Paper was presented for discussion at the Ninth Annual Conference of the Association of Public Lighting Engineers in Blackpool on the morning of Sept. 7, 1932, and arrangements have been made for its further discussion at the Fourth Autumn Research Meeting of the Institution of Gas Engineers in London on Nov. 1 and 2, 1932.

Copies of the Paper can be obtained—so long as the supply lasts—from Mr. J. R. W. Alexander, the Secretary of the Institution of Gas Engineers, 28, Grosvenor Gardens, London, S.W. 1, price 1s. 6d. each, including postage.

The Paper consists of 88 pages, and in the appendices alone there are no fewer than 40 diagrams and 12 tables, which cover the data required for the planning of most normal installations for street lighting by gas, in accordance with the Classes specified in the British Standard Specification.

THE NEWS OF THE WEEK

Aberdeen Corporation Gas Department are at present exhibiting at the North of Scotland Industry Exhibition at Aberdeen.

The Dundee Gas Committee has approved of an offer amounting to £6683 to make a sure foundation for the Lochee gasholder which tilted some time ago.

Seventy Thousand Copies of an attractively coloured card, drawing attention to the comfort and convenience of the modern gas fire, are being sent out by the Newcastle-upon-Tyne and Gateshead Gas Company as a commencement to their winter gas fire campaign.

The Transactions of the Institution of Chemical Engineers have just been published by the Institution at Abbey House, Westminster, S.W. 1. It is, as usual, a very complete work, covering the activities of the Institution during the year 1931, and there is in it much of interest to the Gas Industry.

Price Reductions in Scotland.—As from November the price of gas at Kelso will be reduced by 2d. per 1000 c.ft. to 3s. 7d. for power and 4s. for ordinary consumption. At Inverness the price is to be reduced by 3d. per 1000. At Kirkcaldy the Manager has recommended a reduction by 2d., to take effect as from the first reading after May, 1932. The new price would in this case be 3s. 9d. per 1000.

Consideration is Being Given by the Mossley Gas Committee to a proposition for the formation of a joint gas authority for the towns of Mossley, Stalybridge, Dukinfield, Hyde, and possibly Ashton. Hyde, like Ashton, has a private company, but each of the other three towns has a municipal gas undertaking. As the several towns already have a joint electricity and transport board, there is a reasonable prospect of a joint gas authority being established.

National Smoke Abatement Society.—Representatives of the Gas Industry will take an important part in the annual conference of the National Smoke Abatement Society which is to be held at Newcastle-upon-Tyne from Sept. 23 to Sept. 25. Mr. A. B. Roxburgh, Mr. James M. A. Mitchell, and Mr. Oswald Nicol are to attend on behalf of the British Commercial Gas Association, while Mr. F. P. Tarratt (Senior Vice-President) will represent the Institution of Gas Engineers.

Sales of Gas and Residual Products by the Maryborough (Queensland) Gas and Coke Company, Ltd., for the half-year ended June 30, 1932, show a considerable falling off as compared with the corresponding period of last year, due to the continued trade depression, but against this a saving has been effected in expenditure of an amount almost equal to the loss of revenue. After writing off £300 for depreciation, and making provision for all other charges, the profits amount to £990. To this amount has to be added the sum of £364 brought forward from last half-year, making the total amount at credit of profit and loss account £1354. The Directors recommend payment of a dividend of 6 p.ct. per annum amounting to £1237, leaving a balance to be carried forward of £117. A new tar distilling plant is at present under construction at the works.

The Bombay Gas Company.

The Bombay Gas Company, states the "Financial Times," has come successfully through a period of unexampled difficulty, the effects of which have been heightened by the political upheavals, now happily, in the main, overcome.

The maintenance of the interim dividend at 3½ p.ct. actual conveys a measure of reassurance useful in these times of uncertainty. Last year the interim payment was followed by a final of 4½ p.ct., thus bringing the total up to 8 p.ct., to which it had been raised in the previous year. This, appropriately enough, coincided with the renewal of the Company's contract with the Bombay municipality for a further term expiring in February, 1935.

Gasfitting Classes at Coventry Technical College.

Of the 252 classes to be held at the Coventry Technical College during the 1932-33 session, a considerable number will be of great service to ambitious young men engaged in the Gas Industry.

In addition to the classes in mathematics, chemistry, commerce, &c., there will be four in gasfitting. The work at the first of these will prepare candidates for the examination, Grade I., of the City and Guilds of London Institute. At the second, the instruction given will include the principles necessary for calculations used in the gasfitting trade, and practical illustrations of their application will be provided, while instruction will be given also in the properties of gases, pressure, temperature, and volume; the usual constituents of town gas and their properties, and the heating value of gases. This course will be mainly of a descriptive character, and will be illustrated as far as possible by practical demonstrations. Two other classes will cover the first year's work of the two years' course necessary to prepare candidates for the Grade II. examination of the City and Guilds of London Institute. Students are being enrolled this week and the classes will open next week.

Institution of Gas Engineers.

Student Membership.

Recent applications for admittance to Associate Membership of the Institution of Gas Engineers, from candidates possessing the Higher-Grade Certificate in Gas Engineering, indicate that candidates are frequently not aware they must not be under 25 years of age at the time of their application, unless they have been admitted Students of the Institution, when they are eligible for election if not under 21 years of age.

By-Law 16, relative to admittance to the class of Student, reads:

> Students shall be persons not under 18 and not over 24 years of age who either (1) possess the Ordinary Grade Certificate of the Institution or the predecessors of the Institution, and are undergoing engineering training in the Gas Industry of a character approved by the Council, or (2) are studying for the B.Sc. Degree in Gas Engineering as Internal Students of a British University.

Elections to Studentship are made by the Council. There is no Entrance Fee and the Annual Subscription is £1.

The appropriate Form of Application can be obtained from the Secretary of the Institution of Gas Engineers, 28, Grosvenor Gardens, London, S.W. 1.

An Electrical Eclipse.

In last week's "JOURNAL" we described and illustrated the wonderful floodlighting of the Museum Gardens, York, by the York Gas Company during the meeting of the British Association. The night of Saturday, Sept. 3, was certainly a triumph for gas. Local advocates of electricity had put forward the argument that you know where you are with electricity as "it is either full on or full off." On the night of Sept. 3 electricity in York was certainly "full off." A straw mattress which had been thrown into the river blocked up the intakes for the condensers and so caused the trouble. A bright spot, however, was the brilliantly gas-lighted Museum Gardens and Abbey.

For once in a while the Daily Press dealt with the affair faithfully, as the following quotation from a leader in the "Yorkshire Herald" shows:

"It seemed to us exceedingly ironical that while the British Association for the Advancement of Science was

THE NEWS—*continued.*

meeting at York there should be such a dismal failure of the most boasted method of scientific lighting. Tradesmen who still adhere to the old and well-tried system of gas lighting undoubtedly had the advantage of their neighbours. The incandescent lights shone with a brilliance which equalled the electric bulbs at their best and made them appear mere derelicts at their worst. . . . While so many of the shops were in darkness there was brilliant illumination in the Museum Gardens, where the Abbey ruins were floodlighted not by electricity, but by gas. . . . It was gas that held its own against its more recently conceived scientific rival. The triumph was pronounced."

An Old-Established Utility Company.

The European Gas Company was the subject of a note in the "Potential Investments" column of a recent issue of the "Financial Times," when it was remarked that a thoroughly sound financial structure is shown by the conservative valuation of the last balance-sheet.

The Company, it was stated, was established so long ago as 1835 and was registered as a public company on August 4, 1859. The Undertaking operates in France, owning gasworks at Amiens, Bolbec, Boulogne, Caen, Havre, Nantes, Rouen, and Sotteville.

In March, 1930, the form of the Company's constitution was altered to bring it into conformity with modern practice and to enlarge the Company's objects. At the same time sanction was accorded to the conversion of the then £10 shares into stock transferable in £1 units, and powers were also given to capitalize profits, the undivided surplus being carried to a general revenue account.

Since 1926 the interim dividend has been 2 p.ct., but on account of the current year this dividend (payable on Oct. 1) has been raised to 2½ p.ct. free of tax. At the current quotation of 120 the return on the stock is 4⅜ p.ct., free of tax, per annum on a 5¼ p.ct. dividend basis.

Mr. Ralph Halkett Discusses the Merits of Gas for Street Lighting.

[*From the "Sheffield Daily Telegraph."*]

Citizens of all classes are interested in the question of street lighting. Motorists and pedestrians alike are anxious that streets should be lighted efficiently and cheaply, for they realize that the efficiency increases safety in these days of busy road traffic and that the cheapness means lower rates, which are desperately needed in these times of financial stringency.

Mr. Ralph Halkett, General Manager of the Sheffield Gas Company, in an interview with the "Sheffield Telegraph," related the special claims of gas to be regarded as the most efficient and the cheapest means of street lighting. He also mentioned a number of important contracts obtained recently by the Company, quoting these as evidence of the realization of the qualities of gas by local authorities.

His expression of the opinion that for public lighting gas was more efficient than electricity was expected, but he was able to refer to important facts in support of his contention. On the question of cost he was very definite that gas was cheaper, and emphatic that gas could fear no fair competition from electricity.

Illuminating Figures.

In London, he said, 47 local authorities use gas for street lighting and 22 use electricity for the purpose. There are 55 miles of streets lighted by gas in London, and in most of the well-known thoroughfares in the heart of the capital gas provides an efficient illumination. Such extensive use of gas is not confined to London, however, and actually the latest official figures show that throughout the country there has been a 4 p.ct. increase in the use of gas for public lighting during the past twelve months.

Mr. Halkett proved the increasing demands made upon the Sheffield Gas Company by referring to a series of important contracts recently placed with them. He pointed out that a contract has just been renewed between the Dronfield Urban District Council and the Sheffield Gas Company whereby the latter will supply gas, overhaul and maintain 114 street lamps in the Dronfield district. Also, he said, a contract has just been renewed between the Chesterfield Rural District Council and the Sheffield Gas Company whereby the latter will supply gas, overhaul and maintain 81 street lamps in the Unstone, Apperknowle, and Summerley districts.

A new installation consisting of 55 gas street lamps has just been completed on the Sheffield Corporation Greenhill Estate, and arrangements completed for the Company to take over the lamps and supply gas, overhaul and maintain the lights.

In the district of Tankersley, in the area of supply of the Company, a contract has just been completed between the Wortley Rural District Council and the Company for the erection of 53 street lamps in the district of Tankersley. In the districts served by the Wortley Rural District Council there are already 512 gas lamps in operation.

It is also interesting to note that arrangements have now been completed between the Wortley Rural District Council and the Sheffield Gas Company whereby a further contract has been placed for the supply of gas and complete internal piping installation in 100 houses for lighting, heating, and cooking purposes, and this is in addition to 165 houses already completed.

The Urban Council of the Township of Hoyland, which is situated in the area of the late Elsecar, Wentworth, and Hoyland Gas Company, and which has now been taken over by the Sheffield Gas Company, at their last meeting recommended that the first instalment of 30 bungalows to be erected in their area should have gas for lighting, heating, and cooking. The whole of the public lighting in this area is by gas.

An Important Test.

These instances of the continued and extended use of gas should be regarded as proof of efficiency in service, said Mr. Halkett. The diffusion of a gas light was better than that of an electric light, particularly in foggy weather, he said, and important experiments had indicated the superiority of gas from the point of view of motorists.

These experiments were conducted by the Lewisham authority on a mile stretch of road, portions of which were lighted by gas and other portions by electricity. The result of the tests was unanimous agreement that the section lit by gas was the best and the authority decided, as a consequence, that all its thoroughfares over 50 ft. in width should have gas illumination.

Prominent motorists took part in those tests and Mr. Halkett quoted the published opinion of Mr. Kaye Don that gas "provided the most reliable and evenly-diffused lighting."

Metropolitan Gas Company of Melbourne.

Speaking at the One Hundred and Ninth Half-Yearly Meeting of the Metropolitan Gas Company of Melbourne, held at the Offices of the Company, on Thursday, July 28, 1932, the Chairman of Directors (Sir John Grice) said: The revenue from gas sales was £583,643. A further reduction in the price charged per 1000 c.ft. of gas consumed and a continued diminution of output are both contributing factors to the decrease of £63,657 in receipts from this source over the same period of 1931.

Sales for the six months ended June, 1932, were 1,849,415,000 c.ft., in comparison with 1,894,961,000 c.ft. for the like half of 1931—a reduction of 45,546,000 c.ft., or 2·4 p.ct., which, in view of prevailing conditions, must be regarded as satisfactory.

During the half-year under review 107,850 tons of coal were carbonized; 401,818 gallons of oil and 8587 tons of coke were utilized at a total cost of £200,977, against 117,785 tons of coal, 471,395 gallons of oil, and 8029 tons of coke, totalling £220,350, for the similar period of last year.

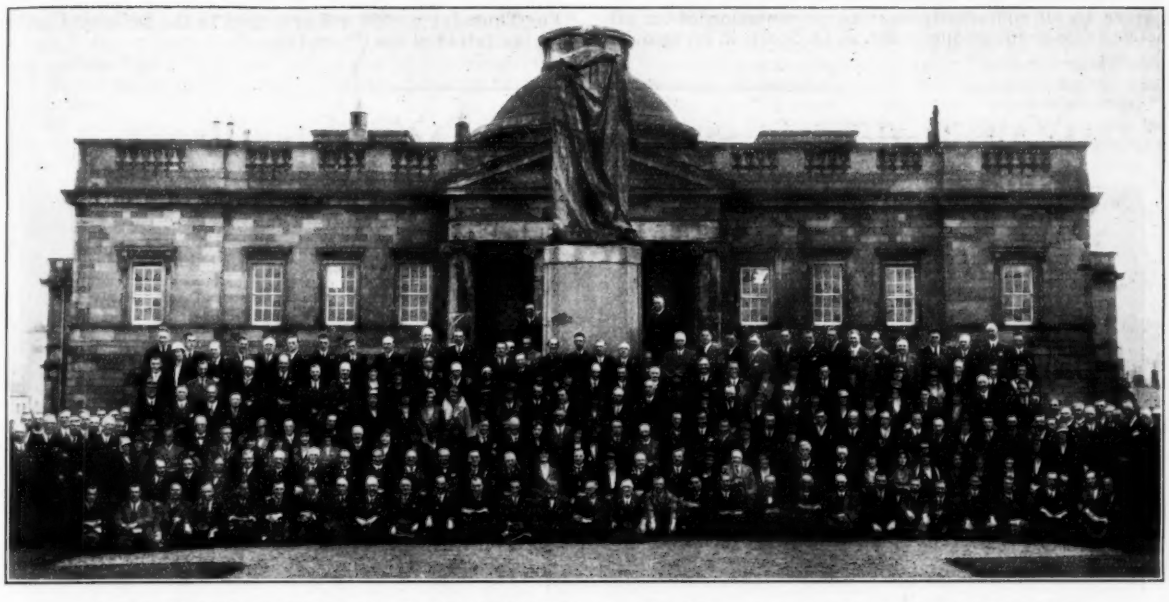
Revenue from residuals for the half-year ended June 30, 1932, shows a decrease of £4531—the total net receipts being £84,821, as against £89,352 for the corresponding period of 1931. Although a reduction is shown in the total tonnage sold, the demand for coke fuel, under existing conditions, has been well maintained, the revenue improving to the extent of £4453, consequent upon a greater proportion of higher grade coke being sold, resulting in an increased average price per ton.

The net profits for the half-year just completed were £102,775. From this amount £15,000 has been transferred to the reserve fund, and the Directors now recommend that a dividend at the rate of 6s. 6d. per share (equal to a return of 7·97 p.ct. per annum on the whole of the share and premium capital subscribed by shareholders) be authorized for the half-year, leaving an amount of £3275 to be added to the carry forward, making this balance £57,045.

The business in appliance sales indicates a definite improvement in trading conditions, sales of cooking stoves for the half-year being 1667, compared with 1071 for the June half of 1931.

North British Association Meeting

THE SOCIAL SIDE



NORTH BRITISH ASSOCIATION OF GAS MANAGERS AT AYR, SEPT. 8—MR. T. W. HARPER, PRESIDENT.

Gas men from far and wide in Scotland, and many visitors from south of the Border, including the President of the Institution of Gas Engineers and the Chairman of the "B.C.G.A.," assembled in Ayr last week for the 71st Annual General Meeting of the North British Association. Under the Presidency of Mr. T. W. Harper, Engineer and Managing Director of the Ayr Gas Company, the three days of business and pleasure passed all too quickly; but they will long be remembered with a feeling of gratitude to the President, to Mr. Kellock (the Secretary), and to the hard-working Members of Council who helped to perfect the arrangements.

The business meeting on Thursday, at which the Presidential Address was presented, together with outstanding papers by Mr. Jamieson, of Edinburgh, and Mr. Philp, of North Berwick, is being dealt with in the "Technical Record." In the evening the Town Council of the Royal Burgh of Ayr offered a Civic Reception in the Town Hall. Provost Thomas Wilson received the guests with an address of welcome; and an excellent concert was given under the direction of the Burgh Organist, Mr. Herbert Pennington. The soloists were Miss Margaret Hunter and Mr. Stephen Cosh. At its conclusion Mr. Harper proposed a hearty vote of thanks to the Provost and Magistrates, the floor was cleared, and a dance was given by invitation of the Gas Company.

The Ayrshire Coast and district is a Mecca for Burns Pilgrims and others of more prosaic tendency; and to this is possibly due the fact that no all-day excursion was arranged for the Friday. In the afternoon, however, there was a visit to the magnificent bathing lake at Prestwick, where afternoon tea was served; the party being the guests of the Provost and Councillors of that Burgh.

President's Lunch.

Between the sessions of the Business Meeting, the President gave luncheon to some forty friends at the Station Hotel, where Mr. R. E. Gibson (President of the Institution of Gas Engineers) and Sir Francis Goodenough, C.B.E. (Chairman of the "B.C.G.A."), were the guests of honour. The Loyal Toast was followed by only one other—that of "The President."

Mr. Gibson, in proposing the toast, said that Mr. Harper was to be congratulated not only on being the successful Manager of a Gas Undertaking, but on obtaining his colleagues' recognition by election as President of the Association. He had delivered an excellent address, for which all were indebted. Speaking as President of the Institution, he (Mr. Gibson) could say how generally were appreciated the services of Mr. Harper and of the North British Association to the Institution. Mr. Gibson said he had last attended a Scottish Meeting in 1901, when Mr. (later Sir George) Livesey had presided over the International Gas Congress. Then they had been warned of the growing competition from oil and electricity. That was thirty years ago; and gas was still carrying on successfully in spite of it.

Mr. Harper, in graceful acknowledgment, said that such a day as he was enjoying was a red-letter one in the history of any Gas Engineer, for it signified that he had attained the hall-mark of his professional brethren. Every man should have the chance of coming up to the chair.

Sports Meetings.

The Golf Competition for the Association Challenge Bowl and other prizes took place on Wednesday over the Belleisle Course at Ayr; 64 Members taking part. The trophy and memento were won by Mr. Alex. Mackenzie, of Dunblane, with a score of 89 less 14 = 75. The Scratch Prize went to Mr. James Brock, the Scottish Internationalist, with a score of 75. The Handicap Prizes were won as follows:

HANDICAP PRIZES.

Section 1.

(Those with handicaps up to and including 15.)

	1st	Alex Mackenzie, Dunblane
Tie	2nd	A. Cuthbert, Grangemouth
	3rd	G. A. Mitchell, Glasgow
Tie	4th	R. M. Cairns, Glasgow
	5th	J. H. McKellar, Glasgow

Section 2.

(Those with handicaps above 15.)

	1st	J. E. Blundell, Carlisle
	2nd	Lewis Fletcher, Glasgow
	3rd	W. B. Hudson, Manchester
Tie	4th	E. V. Chalmers, Dunblane
	5th	Allan Young, Edinburgh

By courtesy of the Ayr Bowling Club, the Competition for the Bowling Cup took place on their green in Wellington Square. The following composed the winning rink: Messrs. J. Richmond, Penicuik; W. H. Handley, Elland; J. Hamilton, Ayr; and W. Mann (Skip), Stevenston.

After play, the Annual Meeting of the Golf Circle was held; Mr. James Bell, Captain, in the Chair. At the outset he referred sympathetically to the great loss sustained by all through the deaths of Mr. George Keillor and Mr. Campbell Dunlop, whose enthusiasm, good nature, and sportsmanship had endeared them to all. The members stood in reverence to their memory.

Formal business having been transacted, Mr. Bell offered a hearty welcome to Mr. W. Clark Jackson, of Neath, who was a visitor to the meeting, and announced that Mr. John Wilson, of Dundee, had been co-opted on the Golf Committee in place of the late Mr. Keillor. Mr. James A.

Maclay was then elected Captain and Mr. Scott re-elected Secretary and Treasurer for the ensuing year; both votes being received with much enthusiasm. Mr. Bell then introduced Mrs. Harper, who graciously distributed the prizes.

The concluding function, and one which gave the keenest pleasure to all concerned, was the presentation of an all-electric radio-gramophone to Mr. J. O. Scott, in recognition of thirty years' ungrudging service as Hon. Secretary of the Golf Circle.

"AT HOME."

The ladies again had a special programme of enjoyment, including a putting competition on Wednesday. Afterwards Mrs. Harper was "at home" at the Bowling Green. For Thursday a visit was arranged to the Belleisle Gardens, by invitation of the Town Council.

Association of Statutory Gas Meter Inspectors

Photograph taken on the occasion of the visit of the Association of Statutory Inspectors of Gas Meters to the Edinburgh Works of Messrs. Alder & Mackay, Ltd., on Sept. 2.

NOTES ON PLANT AND PROCESSES

Renolds and Coventry Products for Industrial Applications.

A new catalogue of their products for industrial applications has been published by the Renold and Coventry Chain Company, Ltd.

Consequent upon the continued and increasing growth of the use of 8 m/m and ¾-in. pitch roller chains for industrial applications, and in pursuance of their policy of passing on economies of production to customers, the firm have made substantial reductions in the price of these sizes of chain.

Attention is drawn to the fact that there will shortly be available a complete range of speed transformer boxes, and pending the publication of a leaflet concerning these, the Company will be pleased to deal with any individual inquiries.

The complete technical services of their predecessors, Hans Renold, Ltd., and the Coventry Chain Company, Ltd., have now been centralized, and all communications should be addressed to Renold Works, Didsbury, Manchester, or any Branch Offices.

Adamson Steam Turbines.

An interesting brochure dealing with the firm's steam turbine plant, including illustrations of various installations put down, has recently been published by Messrs. Daniel Adamson & Co., Ltd., of Dukinfield.

The whole of the firm's twenty-five years' experience in turbine design and manufacture has been devoted entirely to the development of one approved type, which enables them to offer thoroughly reliable machines, embodying the latest improvements, which are the result of progressive efforts over this long period.

After describing some of the more important details of the machines, the brochure goes on to deal with the oil-pressure control governor gear, in connection with which the absence of pilot valves is emphasized, the variation in oil pressure operating on the underside only of each of the three oil pots. Each pot is adjusted to operate at a different pressure, so that they come into operation successively, controlling automatically up to 25 p.ct. overload. The main oil pump situated at the bottom of the governor drive centre line delivers oil under pressure to the three-way connection; from there to the three-way branch pipe. This branch feeds the three oil pots and the port over which the governor sleeve operates. When load comes on the speed tends to fall, which causes the governor weights to close slightly, causing the governor sleeve slightly to close the oil port, resulting in a small increase of oil pressure, this increase of oil pressure actuates the oil piston of the pot that is governing, and so admits more steam to meet the increased load demand. The reverse takes place when load decreases. The springs in the three pots are adjusted to operate at different oil pressures, so that each pot takes up its work of control in rotation.

Only a portion of the hot oil from the main oil pump feeds the control pots, the rest passes through a cooler and strainer, and on to the bearings, and no matter what the governor demand is, the oil quantity and pressure to the bearings remain constant.

Bamag-Meguin Resonance Screens.

The Bamag-Meguin A.G., of Berlin, have published a new brochure illustrative and descriptive of their resonance screens, which are particularly suitable for gas-works coke-handling plant.

The Bamag-Meguin resonance screen is the result of exhaustive research, with a view to increasing the efficiency of screening and classifying equipment. These new shaking screens are based on the resonance principle, and give highest capacities with minimum power consumption, without transmitting any vibration to the buildings, &c.

The coke-screening plant at the Kassel Gas-Works (Germany) was the first plant equipped with self-balanced shaking screens, and has given entire satisfaction since October, 1928. Since that date more than eighty plants for different kinds of material, such as coke, coal, lime, &c., have been erected, and have given very good results.

The most suitable design is obtained by arranging two screen frames in one supporting frame, one after the other in the same conveying direction, to suit the arrangement

of hoppers below the screening plant. The material first falls on the screen with the smallest perforation, and is then classified on the following screen plates, which have larger holes. In larger installations the material to be screened is often passed before the crusher over a pre-screen in order to facilitate the working of the crusher.

The crushed material and that falling through the pre-screen is then classified on the two main screens—arranged one after the other—into different grain sizes. The first main screen frame is driven by means of the connecting rod. The second main screen and the pre-screen swing entirely free.

If the material to be screened has not to be conveyed along the total length of the screening plant, the screen frames are arranged partially one above the other in opposite conveying directions. In this case the material is fed in at the centre of the screening plant, the overlapping part of one screen frame serving as pre-screen for the other one.

An Attractive New Fire Catalogue.

Something striking as well as useful is always to be expected from the new catalogues of Messrs. R. & A. Main, Ltd., of Gothic Works, Falkirk, and the 1932-33 season gas fire publication is no exception.

Bound in an attractive cover, on the front of which is a reproduction in colour of one of the new "Gloria" fires set in marble surround, the catalogue sets out to show how the extensive choice of beautiful gas fires is steadily increasing year by year. Attention is drawn to the radiants of "Main" gas fires, which are the outcome of a long period of research and experiment with various designs and makes. The new "Duramain" radiant, because of its durability without loss of efficiency, is a great asset in the maintenance of fires. From its fine design, the nature of its constituents, its method of manufacture, and from the severe tests to which it has been subjected, the "Duramain" radiant is claimed to be without doubt a definite step in the direction of the ideal gas fire radiant.

The well-known series of "Main" fires are dealt with in turn, with illustrations and full specifications of each—including the "Author" series, the "Shakespearean," the "Baronial," the "Cinderella," together with various types of inset and "Mainscreen" fires, while an interesting section is devoted to different designs of gas fire mantels, with hearth complete, all ready to be fixed into the wall openings.

A special feature is made in this catalogue of the "Gloria" fire, a centre spread in colour illustrating one of these in a beautiful setting. The "Gloria" is a notable departure in design which offers distinct possibilities in the decorative treatment of the fireplace. It is conceived on a skilful handling of circles and half-circles in various checks to give light and shade.

The flat planes, the absence of a protruding canopy, and the introduction of a very shallow fender, all ensure minimum projection into the room space, while it can be fitted at any height from the floor level to conform to any proportion desired.

The final section of the publication deals with types of radiators, including the "Romain" panel heater.

GAS MAKING FROM COFFEE BERRIES.

Trials in Brazil.

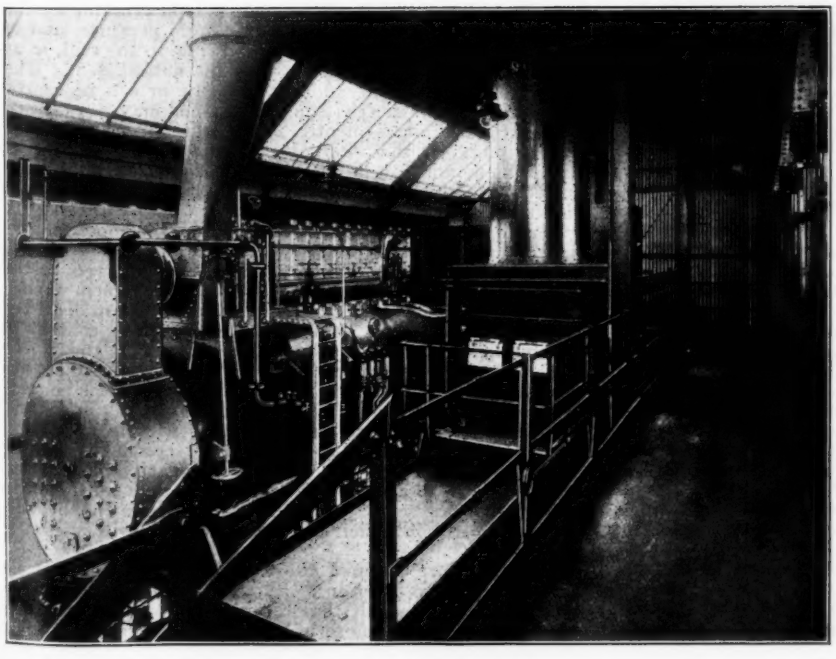
There has during the past year or two been an overproduction of coffee in Brazil which has forced the price down to such an unremunerative level that it is reported three million bags of coffee were destroyed during the past year. In this connection it is interesting to learn from the "Revista Brasileira de Engenharia" that experiments have recently been made to produce gas from coffee berries by "pyrogenation," and also to utilize the berries in the form of agglomerated briquettes for boiler firing. Trials of both these plans have lately been made at the gas-works both in Santos and Rio de Janeiro. Unfortunately the results obtained have not so far been very encouraging.

An analysis of the available stocks of coffee gives the following content: Volatile matter 71 p.ct., water 9 p.ct., ash 4 p.ct., and fixed carbon 16 p.ct. The heat value of the berries is 2500 calories per lb., but by reason of their shape it has been found that they cannot be used in the ordinary form of boiler furnace.

As regards the making of gas from coffee, the Brazilian Journal states that at the Santos Gas-Works it was not found possible to pass more than 2 tons of the berries through the retorts before operating difficulties were experienced. Moreover the heating value of coffee gas is only 3860 calories per cub.m., and is therefore not suitable for distribution. The residual coke also is very light and porous and cannot be put to the same uses as coke obtained from coal.

The conclusion of those responsible for the tests is that, while it is not impossible to obtain better results from coffee, these can only be achieved by modifications in the entire plant of the gas-works. Finally, the experiments show that, while it is difficult to produce fuel briquettes from the raw coffee berries after the latter are carbonized at low temperature, briquettes with a heating value of from 2700 to 2860 calories per lb. can be produced, and further research work is being carried out in this connection.

Waste-Heat Recovery at Hampton Court Gas-Works



The Spencer-Bonecourt advertisement on page 531 of our last issue referred to the waste-heat boiler installation at Hampton Court Gas-Works. Unfortunately, the wrong illustration was used, the boilers shown being the Spencer-Bonecourt installation at the Normanby Park Steelworks of Messrs. John Lysaght, Ltd., at Scunthorpe. The correct illustration is shown here. The advertisement will be properly presented in the next insertion.

Naphthalene Removal During Benzole Washing

K. Brüggemann, in "Brennstoff-Chemie," 1932, 13, 329-334 (Sept. 1), discusses the naphthalene problem and refers to the difficulties attending the exact determination of naphthalene in oils and in gas.

Investigations on naphthalene removal were carried out between January and June, 1931, in a coke oven plant in which ammonia was recovered by the semi-direct process, the gas being cooled to approximately 20° C. before entering the benzole scrubbers. During the period covered by the investigation, the benzole recovery plant was extended. Before the extension, the gas was sent in parallel through two series of three scrubbers and after the extension through two series of four scrubbers.

Naphthalene determinations at the inlet to the saturators and the inlet to the benzole scrubbers showed but small variations, monthly average results being respectively as follows in grains per 100 c.ft.:

—	Jan.	March.	April.	May.
Inlet saturators	36	33	35	39
Inlet benzole scrubbers . .	23	21	20	21

Much of the naphthalene present in the gas entering the benzole scrubbers is removed in the scrubbers, but the actual amount removed depends on a variety of factors and is influenced by the fact that the aim is to recover as much benzole as possible. To this end the benzolized oil is stripped as completely as possible so that the debenzolized oil may possess a high absorptive power. On the other hand, only a small amount of naphthalene is extracted from the benzolized oil; hence conditions for naphthalene elimination from the gas are not nearly as favourable as are conditions for benzole removal.

Before the extension, with a gas make of 15 million c.ft. per 24 hours, the quantity of oil in circulation was 85-90 tons, and the volume of oil circulated was 3300-4400 gallons per hour. For effective stripping of the oil, it was necessary to carry over with the benzole vapours about 4½ tons of wash oil per 24 hours. This was recovered in the preparation of the crude benzole and was returned to circulation after passage through the naphthalene crystallizing pans.

The practice adopted was to withdraw 30 tons of thickened oil and add 30 tons of fresh Solvay oil. To make the most economical use of the oil, the highly absorptive low-boiling oils from the crystallizing pans were not put back into circulation during the two days preceding a withdrawal of thickened oil, but were stored, their amount being 9-10 tons. After addition of fresh oil, these oils which were saturated with naphthalene and contained 12-18 p.ct. of naphthalene were returned to circulation. The effect was that addition of make-up oil did not lower the naphthalene content of the circulating oil even though the fresh oil contained only 2½-3½ p.ct. of naphthalene.

During January, the naphthalene content of the benzolized oil ranged between 6¼ and 9 p.ct., that of the debenzolized oil between 5¾ and 8 p.ct., and that of the debenzolized gas between 2·9 and 3·5 grains per 100 c.ft. In a 55 hours' test carried out to ascertain the effect of not returning oils from the crystallizing pans, the naphthalene content of the benzolized oil dropped from 8·1 to 5·2 p.ct. and that of the debenzolized oil from 7·1 to 4·6 p.ct.

In view of the fact that the debenzolized gas from the original plant contained 12-18 c.c. of benzole per 100 c.ft., the plant was extended and the new plant was put into operation in the middle of March. The quantity of oil in circulation was increased to 100 tons, and 24-25 tons of oil were circulated per hour. With the same method of operation, the average naphthalene content of the oil in circulation became 1 p.ct. higher than with the original plant.

It is interesting to note that the pan oil from the original plant amounted to 4½ tons per day, that from the extended plant being 7 tons. The result was that, even with a longer stay in the pans, no naphthalene crystallized out in the pans. This was to some extent due to the higher temperatures prevailing in April and May, but chiefly to the large amount of oil driven over with the benzole.

The experiment of reducing the temperature of the oil entering the debenzolizing plant from 125-130° C. to 106-110° C. was tried, the amount of steam being unaltered. This method of operation could only be maintained for 15 hours, since, due to insufficient stripping, the content of oils boiling below 180° C. rose to 0·6-0·7 p.ct. in the debenzolized oil.

After the extension, naphthalene contents in the debenzolized gas were 5, 6, and 8 grains per 100 c.ft. at the end of March, April, and May respectively. The increases were due partly to increased atmospheric temperature, but the figures were nevertheless higher than would have been obtained with the original plant. Nevertheless, the naphthalene content of the oil in circulation did not increase, the explanation being that the crude benzole freed from pan oil contained approximately as much naphthalene as had been removed from the gas, and this naphthalene was not returned to circulation. Separation of the crude benzole was carried out in a plant of high efficiency yielding a product with about 95 p.ct. distilling to 180° C., this being refined without re-distillation. The tailings flow continuously into the naphthalene pans.

The daily naphthalene balance in June was as follows for a daily make of 15 million c.ft. of gas:

Inlet to saturators . . .	35 grains per 100 c.ft.	= 750 lbs. naphthalene
Inlet to benzole scrubbers	21 grains per 100 c.ft.	= 450 lbs. naphthalene
Naphthalene removed during cooling . .		300 lbs.
Outlet from benzole scrubbers	7 grains per 100 c.ft.	= 150 lbs. naphthalene
Naphthalene removed in benzole scrubbers		= 300 lbs.

The naphthalene eliminated in the scrubbers thus represents a concentration of 0·14 p.ct. in the 100 tons of oil in circulation and the concentration should increase by this amount each day if no naphthalene were eliminated from the system and indeed, no naphthalene was coming out in the crystallizing pans. The only source of naphthalene removal was in the crude benzole, which contained 1·5 p.ct. of naphthalene. Since the daily make of crude benzole was approximately 9 tons, the naphthalene contained in the crude benzole was very nearly equal to the amount eliminated from the gas.

For reducing the naphthalene content of the gas to a low value, the only means is to practise naphthalene removal with the same principles as are applied in benzole removal—*i.e.*, the circulating oil must be stripped as completely as possible from naphthalene, and the oils removed at the same time must be reduced to a low naphthalene content before being restored to circulation. Moreover, in the warmer months, the oil and gas entering the scrubbers must be cooled as much as is possible. The stripping of the oil must be maintained at the optimum point as regards the attaining of the maximum content of naphthalene in the oil distilled over with the benzole compatible with complete debenzolizing of the oil.

For the elimination of naphthalene from the distillate oil, cooling even to a temperature well below 0° C. is useless, due to the high solubility of naphthalene. Laboratory tests indicate that steam distillation of the oils offers a solution. By the steam distillation of 100 parts of pan oil until the distillate no longer showed naphthalene on cooling, the distillate on being filtered yielded 11-13 parts of naphthalene cake and 8-10 parts of filtered oil. The distillation residue contained only 1·5-2·2 p.ct. of naphthalene; hence approximately 90 p.ct. of the naphthalene was eliminated. This procedure should work equally well in practice. It is necessary to provide a dephlegmator for the vapours, to use steam only at a minimum pressure, and to maintain a temperature as low as possible in the still, so as to minimize distillation of oils with the naphthalene. The distillate can either be added to the tar or can be centrifuged, in which latter case the oil obtained may be returned to the still for re-treatment. The residual oil from the still (75-80 p.ct. of the charge) contains about 2 p.ct. of naphthalene and can be returned to circulation after being cooled. No thickening of the oil is to be anticipated as a result of this distillation.

Consequent on the elimination of naphthalene from the pan oil, the time will arrive when the circulating oil will contain so little naphthalene that it is able to reduce the naphthalene content of the gas to a mere trace. When this stage is reached, it is only necessary to steam distil the pan oil occasionally. Thus, if the naphthalene content of the oil in circulation is reduced to 1·5 p.ct., and if the naphthalene concentration increases by about 0·1 p.ct. per day, it will take about 14 days for the naphthalene content to reach the permissible upper limit of, say, 2·9 p.ct., and it is only then that steam distillation will be necessary. An alternative and continuous method could be adopted when the naphthalene content of the circulating oil has been brought down to a low value—namely to pass continuously the warm heavy ends obtained from the once-run benzole through a still in which a short treatment with steam is given.

The procedure outlined above should enable the benzole scrubber itself to function as a highly efficient naphthalene washer, with the result that the installation and operation of a costly naphthalene scrubber would be avoided.

THE "JOURNAL" TECHNICAL RECORD

Which contains Reports of Meetings of Gas and Allied Associations

North British Association of Gas Managers

ANNUAL MEETING AT AYR

The Seventy-First Annual General Meeting of the North British Association of Gas Managers was held in the Town Hall, Ayr, on Thursday, Sept. 8, and was largely attended, over 200 members and friends being present. Mr. T. W. HARPER, Engineer and Managing Director of the Ayr Gas Company, occupied the chair as President of the Association.

CIVIC WELCOME.

Provost WILSON (Ayr), in extending to the members the greetings of his Town Council, said the Industry whose problems they were that day met to discuss originated in Ayrshire. The discoveries of William Murdoch at Lugar must have given those associated with the manufacture and distribution of gas a warm feeling towards Ayrshire. As a Town Council they were glad that the members had come to the district, and they could be assured of fitting hospitality.

Mr. JOHN GIBSON, Chairman of Ayr Gas Company, said that on behalf of his co-Directors he had to offer the members of the Association heartiest greetings on the occasion of their visit to Ayr. They did so all the more heartily since the President was Mr. T. W. Harper, the respected Manager of Ayr Gas Company, Ltd.

The PRESIDENT acknowledged the welcome.

OBITUARY.

The PRESIDENT referred to the death since the last meeting of the Association of Mr. George Keillor, of Greenock, one of the ordinary members, and of Messrs. J. F. Sutherland, Kirkcudbright, and James McKelvie, Edinburgh, two of the extraordinary members. By his service to the Industry—in Greenock and elsewhere—Mr. Keillor built up a high reputation for himself. He was a gentleman of upright character who was possessed of a strong sense of responsibility. They regretted his loss, and the circumstances associated with his death came as a great shock to them all. The sympathy of the entire membership would be extended to the widow and her family.

The members stood in their places as a tribute to the memory of the deceased.

THE INSTITUTION'S PROGRESS.

The PRESIDENT commented upon the presence on the platform of Mr. R. E. Gibson, of Liverpool, the President of the Institution of Gas Engineers. They extended to him the heartiest of welcomes, and would be delighted to have a brief address from him.

Mr. GIBSON reminded the Association that some of the most valuable and distinguished members of the Institution which he represented as President came from the Scottish side of the Border. The Institution was much indebted for the support it received from the members of the North British Association. As far as the Institution was concerned, he believed it was more alert and efficient at the present time than it had ever been before. It had a membership of 1500—about 1000 full members and 500 or so of associate members and associates. The fact that the Royal Charter was conferred upon the Institution some time ago was an event of importance, and membership of the Institution might now be regarded quite properly as the hallmark of the gas engineer. It was most desirable that the members of the North British Association should at the same time be members of the Institution. The Institution was identified with many activities for the benefit and advancement of those associated with the Gas Industry. In the spheres of education and research notable headway had been made.

The research work which had been carried on by the Institution, in conjunction with Leeds University, was bound to be of the utmost value to the Industry. He felt there was room for further research on gas lighting. In regard to street lighting, it was a matter for general satisfaction in the Industry that the Gas Light and Coke Company had entered into a contract to light the main streets in the City of Westminster for a period of fifteen years.

The PRESIDENT thanked Mr. Gibson for his address.

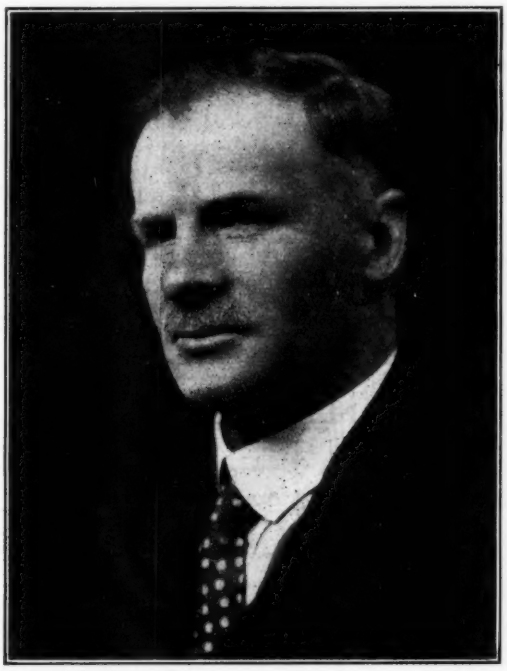
THE COUNCIL'S ANNUAL REPORT.

The PRESIDENT said that copies of the annual report of the Council had already been circulated, and it was unnecessary to recapitulate any of the items appearing therein. The funds of the Association were in a healthy condition.

Mr. A. S. NISBET (Paisley) moved the adoption of the report, which was agreed to unanimously.

PRESENTATION OF CERTIFICATES.

At this stage of the proceedings the President presented the certificates won by students at recent examinations.



THE PRESIDENT,
T. W. HARPER, Ayr.

Mr. Harper received his mechanical training with the Lothian Coal Company, Ltd., and Sir Wm. Arrol & Co., Ltd., Glasgow. After this he was appointed Mechanical Engineer with the Dundee Corporation, and received his technical training in Gas Engineering at Dundee Technical College. He was appointed Gas Engineer to the Forfar Corporation in 1913, and Engineer to the Ayr Gas Company, Ltd., in 1918, afterwards being made Manager Director.

The following were the awards: Higher Grade Gas Supply (Second Class)—F. G. Symon, Motherwell. Higher Grade Gas Engineering (First Class)—D. L. Dickson, Cowdenbeath; J. M. Dow, Perth (with Distinction). Second Class—W. G. H. Heggie, Dundee; W. A. M. Stewart, Kirkintilloch; W. Kirk, Polmont; and N. C. Sturrock, Port Glasgow.

PRESIDENTIAL ADDRESS

of T. W. HARPER, M.Inst.Gas E.

It is now my duty to present to you my Presidential Address. This, I have felt, must be to some extent an account of my stewardship during my year of office.

A year ago you elected me President of our Association. The holding of this office is an honour to my Company as well as to myself, and is one that I value highly. This is

the first occasion that the honour has come to the Royal and Ancient Burgh of Ayr, the county town of Ayrshire. Some fifteen miles from this meeting place is the little village of Lugar in which there is the Old Bello Mill where William Murdoch made his first experiments on the production of illuminating gas from coal. These gave birth to our great Gas Industry, so that it seems to me appropriate that our 71st annual meeting should be held in this " auld toon " of Ayr—to which there clings much of the memory of these great national figures of light, patriotism, poetry, science, and learning—viz., Wallace, Bruce, Burns, and our own William Murdoch.

Ayr Gas Undertaking.

The introduction of coal gas into the old town of Ayr for the purpose of supplying artificial light commenced about September, 1826, so that the Ayr Gas Undertaking is now 106 years old. The first works were laid down by a Company trading under the name of the British Gas Light Company, and about five years later was sold to a local gentleman who, in turn, let the works to a tenant. This arrangement continued until the year 1845, when the undertaking was acquired by a Co-Partnery Company composed of local citizens, the Chairman being the Provost of the Town, and the purchase price £7500. There are no records as to the quantity of gas produced, there being no such apparatus as a station meter. But it is recorded that the first installation of consumers' meters was made in 1847. The price of gas previous to that date had been charged at so much per jet for so many hours per night during the lighting period. The business of the Company continued steadily to increase until 1886 when the output stood at 40 million c.ft. and the quantity of coal carbonized amounted to 4700 tons. The designation of the Co-Partnery Company was now (1886) changed to that of the Ayr Gas Company, Ltd. Business continued to make progress until 1896, when the output stood at 80 million c.ft., so that, in the course of ten years, the output of gas had doubled.

In 1888 the Town Council obtained its first Parliamentary Order to supply electricity under the 1882-86 Electric Lighting Acts. Competition from the local electric undertaking was rather unfortunate for the Gas Company, in that, as soon as the distribution cables were laid, the Council electrified the whole of the street lighting, which meant the loss of supplying light for 750 lamps out of 800. Perhaps it was natural for the local authority to support its own undertaking. The loss of public lighting made a serious reduction in the Gas Company's output, and this steadily decreased until 1918, when the make of gas had fallen back to 62 million c.ft. It was at this stage of the Company's affairs that I took over the management of the undertaking.

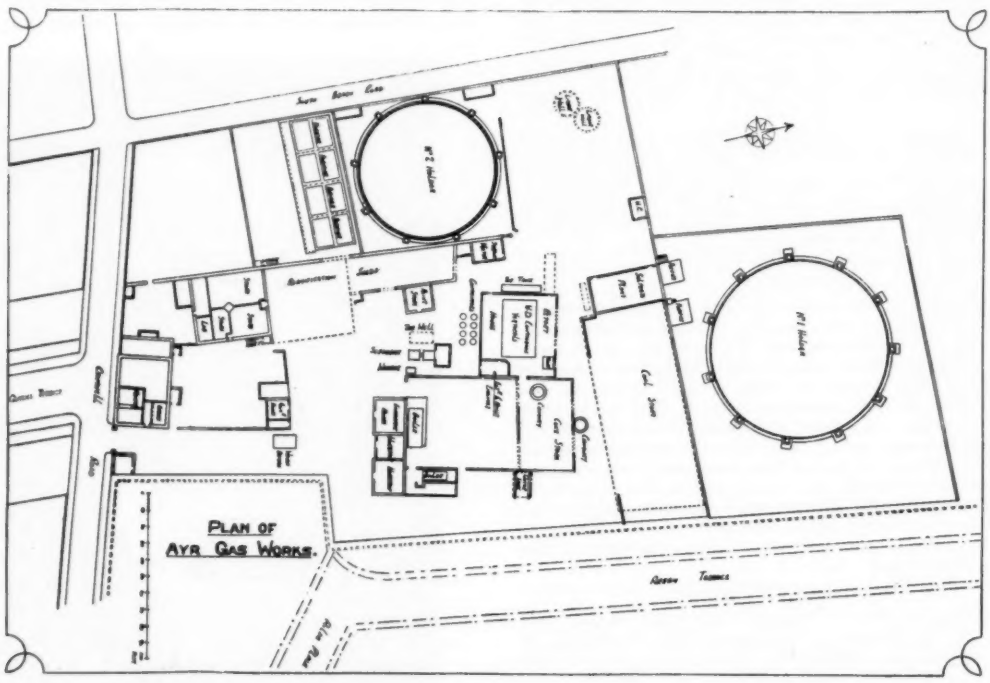
Carbonizing Plant.

Ayr was one of the first Scottish undertakings to adopt vertical retort plant, taking fourth place to Helensburgh, which was the first undertaking to adopt modern carbonization in vertical retort plant in Scotland.

The plant in Ayr consists of eight vertical retorts arranged in units of two retorts with one producer for each unit. The retorts are 25 ft. in length with a throughput capacity of 5 tons per retort per day, and the total throughput for the whole plant—viz., 40 tons per day—gives a daily output of gas of 400,000 c.ft. of 500 B.Th.U. gas when on straight coal gas. The plant is complete in all details according to the standard type of that period, so that it may be said, in all fairness to its working condition, to be out of date in the light of the past eighteen years' experience and the improved design of present-day vertical installations.

The production of blue water gas, by steaming the retorts, was commenced about 1917 and has been carried on up to the present time. By steaming, the production of the installation has been increased to 600,000 c.ft. of gas of 420 B.Th.U., with a reduced throughput of coal varying from 4½ to 4 tons per retort per day, according to the class of coal used. The capacity of the plant is such that an increase in the sales of gas to the extent of 25 p.ct. can be met without in any way adding to the carbonizing plant.

The present plant was put into operation during the fateful month of August, 1914, and in the first four years of its working life was rather unfortunate. This was due, of course, to conditions brought about by the employment of inefficient labour during war years, with the result that between 1918 and 1919 heavy expenditure was incurred to put the plant in reasonable working condition. This entailed taking down six of the eight retorts, a distance varying from 15 to 18 ft., and re-setting them. In addition, all faulty iron and steel work found on auxiliary coal hoppers, bottom coke chambers, and coke dischargers was taken down and renewed where necessary. Then in 1921 one complete unit, of two retorts and producer, was taken down and re-set. Apart from the above replacements, no repairs of a serious nature have been required during the past ten years.



The total amount of coal carbonized during the lifetime of the plant amounts to 94,290 tons, and the quantity of gas produced amounts to 1493 million c.ft. Repairs and maintenance on brick and iron work have cost approximately £2976. It will be noticed from List No. 1 that the cost of maintenance on brick and iron work comes to 7·57d. per ton of coal carbonized. Perhaps this figure may

List No. 1.—Maintenance of Retorts.

Aug. 4, 1914, to Feb 1. 1932.

Coal Carbonized.	Gas Made.	Cost of Maintenance.	Cost of Maintenance per Ton.	Cost of Maintenance per 1000 C.Ft.
Tons.	C Ft.	£ s. d.	Pence.	Pence.
94,290	1,492,908,000	2975 19 9	7·57	0·48

seem to be on the high side, but, when account is taken of the intermittent nature of the working of the plant, and more especially since the plant has not been worked to its full capacity during the past twelve years, the figure for maintenance cannot be regarded as excessive. On the whole, the working of the plant may be considered satisfactory in view of its working period.

The time has come, however, when serious consideration requires to be given to the need for re-conditioning the plant after twelve years' working. It is now somewhat difficult to produce gas of constant composition and thermal value. List No. 2 gives some idea of the working of the plant during the past winter. It has to be noted that no special adjustments on the plant were made during the period when the analyses were taken.

List No. 2.—Gas Analysis Taken Under Ordinary Working Conditions During Winter Months.

Percentage.							Calculated Calorific Value. Corrected to N.T.P.	Calorific Value by Boys' Calorimeter.	Gas Made per Ton.	Therms per Ton.
N_2.	CO_2.	O_2.	CnHm.	CO.	H_2.	CH_4.	B.Th.U.	B.Th.U.	C.Ft.	
11·2	6·0	0·4	2·2	19·8	45·2	15·3	423·7	407·5	19,754	80·5
10·4	5·7	0·4	2·3	21·3	45·1	14·8	427·25	420·5	19,174	80·62
10·4	6·2	0·4	2·4	19·5	44·0	17·1	431·0	424·6	19,569	83·09
9·2	6·4	0·4	2·5	18·0	46·2	17·3	436·2	428·0	19,827	84·86
10·8	6·8	0·4	2·5	19·5	45·8	14·2	420·15	418·3	17,908	74·9
Average 10·4	6·2	0·4	2·38	19·62	45·26	15·74	427·66	419·78	19,246	80·79

Purifiers.

The remaining units of the Ayr Works are designed on standard lines and call for no special comment. Quite recently a new set of purifiers was installed to replace the old boxes which had become too small for existing and future requirements. After erection we had difficulty in maintaining a working temperature in the purifier boxes owing to their exposed position and also to the fact that they are much in excess of present requirements. To get over the difficulty a jet of wet steam was introduced into the pipe line between the scrubber and purifier, but this was of little or no use, as the oxide in the boxes became sodden and created back pressure. It being necessary, therefore, to find some other method of obviating the trouble, it was decided to cool the gas to a temperature as low as possible on the outlet of the scrubbing plant, and then to superheat the gas stream by dry heat before entering the purifier. This was done by fitting a preheater in the pipeline on the inlet pipe to the purifier. By this means the trouble of low temperature in the purifier boxes was eliminated. The fact of heating the gas by means of dry heat has proved of considerable advantage in that the time between the period of changing the purifiers has much increased and at the present time it is possible to foul the oxide up to 50 p.ct. on the second run.

Another difficulty was that, when opening a box for changing the oxide, it was found necessary, after taking off the first six inches, to spray the oxide with water to keep down the dust. It was evident that the action of dry heat had rendered the oxide extremely dry.

Station Meter and Gasholder.

Further, it was found that the water in the station meter had constantly to be made up to working level. This absorption of water from the meter was recovered principally in the inlet syphon box to the gasholder, and a little in the outlet syphon box. It should be mentioned here that, during the last twelve years, we have maintained a film of oil on the water level of the holder tank. This serves a twofold purpose. The oil film lubricates the holder plates during their travel through the water in the tank and obviates corrosion, and also prevents, on a hot summer day, the absorption of the water being carried over with the gas stream. Consequently, our district mains are dry and it is seldom that we get much condensation from our mains and service pipes except that amount of water which may percolate through a perforated service pipe.

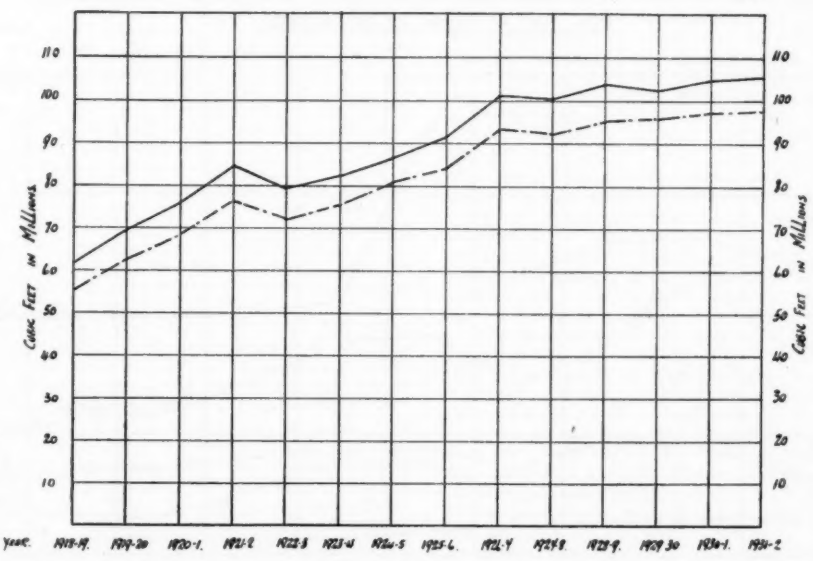
Distribution.

The distribution is very simple, in that there is no need for high-pressure boosting. Our area of supply is a gradual rise from practically sea level to the boundary of supply. The length of main pipes extends to 22 miles, starting with a 16-in. trunk main and terminating with a 5-in., a distance of 4 miles from the works. The pressure is maintained at 45 tenths for 18 hours of the day, and is reduced from midnight to 6 a.m. There being little or no public lighting, the maintenance of the day district pressure is not essential during the latter period.

Graph No 1

Graph Showing Gas Made & Gas Sold Per Annum from 1918 to 1932.

Gas Made. ——— Gas Sold. —·—·—



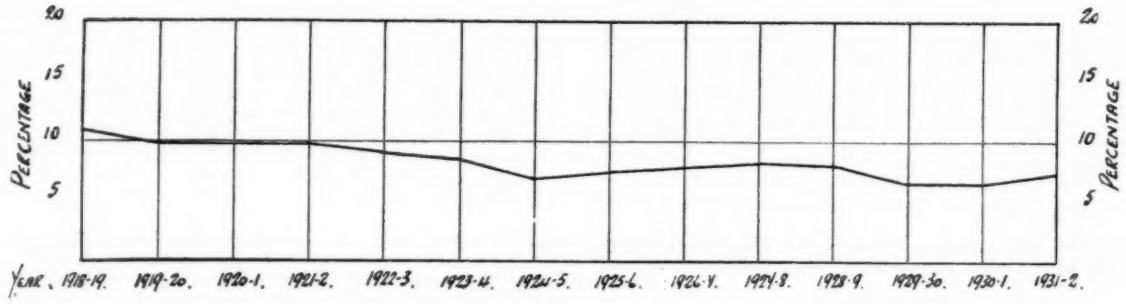
Sales.

The annual sale of gas in 1918 amounted to 57 million c.ft. and for the year ended January of this year the sale

of gas was just over 98 million c.ft.—an increase of 64·72 p.ct. during the period under review. Graph No. 1 shows the increase and decrease in sales of gas between the years 1918 and 1932. Graph No. 2 shows the decrease in the percentage of unaccounted-for gas over the same period from 11 p.ct. to 7·25 p.ct. It will be noted from Graph No. 1 that the output and sales of gas increased steadily between 1918 and 1921, and during the next year there was a decrease. (This was due, I think, to the aftermath of the coal stoppage of 1921.) Thereafter increased output continued until 1929 when progress slows down. This, I think, is due to the increasing state of unemployment

GRAPH Nº 2

GRAPH SHOWING RISE & FALL OF UNACCOUNTED FOR GAS 1918-1932.



during the past three years. The number of consumers has increased from 3200 in 1918 up to 3590 at the end of last financial year, an increase of 390. While there has been a number of new houses built during the post-war years within the area of supply, the increase in the number of consumers does not indicate the number of new houses. Probably a hundred of these were consumers at one time and have since re-commenced the use of gas. The town of Ayr is a residential one, there being practically no industry other than that of catering for visitors. Nevertheless, it has been possible to increase the annual consumption of gas from 16,400 c.ft. to 28,500 c.ft. per consumer during the past fourteen years—an increase of gas consumed per consumer equal to 73·78 p.ct.

Sales of gas are regulated on a sliding basis, starting from a rebate of 5 p.ct. increasing by 2½ p.ct. for each stage up to 15 p.ct. The hiring of gas-consuming apparatus was discontinued during the war years and has not been re-introduced, but there has been substituted a simple form of hire-purchase which has been in operation for the past twelve years. Generally speaking, the bulk of the apparatus installed for consumers is purchased on a first cost basis with the inclusion of a charge for the cost of fitting. This method has been found beneficial to the undertaking in that it keeps down the amount of capital employed and also reduces the number of appliances returned for re-conditioning. The cost under this head is, therefore, comparatively low, tending to reduce the costs of the sales and distribution department and reacting beneficially upon the selling price of gas.

Residuals.

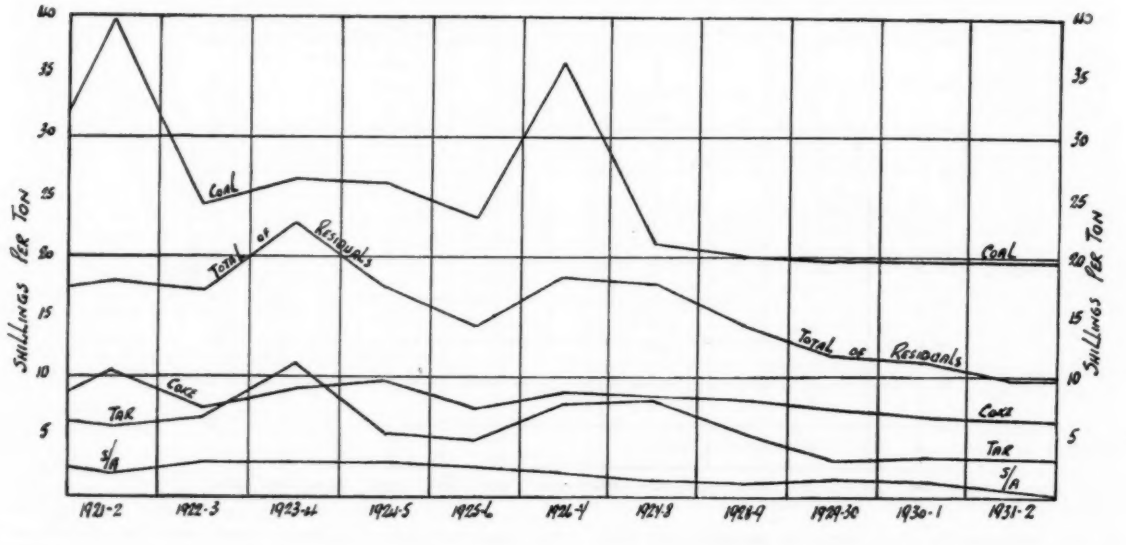
The pressing need of the moment is the reduction of the cost of manufacture in view of the reduced value of residuals.

During the years 1926 to 1927 the value of residuals amounted to as much as 80 p.ct. of the cost of coal. Since then there has been a gradual fall in values, tar in particular falling rapidly, touching its lowest figure about two years ago, after which it remained practically stationary; but values again show an increase during the past six months. The revenue from the manufacture of sulphate of ammonia may be considered a thing of the past owing to competition from synthetic production. To those, however, who require to transport their ammoniacal liquor, a paper to be delivered to-day by Mr. Philp, of North Berwick, on "Concentrated Gas Liquor," will prove interesting.

Coke is the only residual which has maintained anything like stable conditions during the past four or five years, so that I think it will be to the advantage of gas engineers in general to do all they can to improve the methods of increasing the sale of coke as well as to improve the methods of increasing the sale of coke as well as to improve the methods of cleaning and grading. Graph No. 3 indicates

GRAPH Nº 3.

GRAPH SHOWING THE VALUE OF COAL & THE VALUES OF RESIDUALS PER TON OF COAL CARBONISED.



the values of residuals in relation to the cost of coal over the past ten years.

Institution of Gas Engineers.

My year of office, which is now drawing to a close, has been one of increasing industrial depression, culminating in the financial crisis of October last, and bringing with it a cause for deep anxiety to responsible parties not only in our own country but in all other countries suffering from the same world-wide depression, and I know that you all join me in the confidence that there will be an early return to more prosperous and stable industrial conditions. It has also been my duty during the past year to be your representative on the Council of the Chartered Institution of Gas Engineers. Attendance at those meetings has been for me a source of enlightenment, and now that those duties have been delegated to my successor I feel that I have just finished a period of apprenticeship and begun to get a real grip of the business of the Institution.

This Presidential representation, being complementary to the District Presidentship, due to the fact that the period of office is only for one year, serves insufficiently the purposes of our Association or the Institution itself. This matter is now being considered by the District Associations, and it is to be hoped that a more useful form of representation will be the outcome of their deliberations.

Education.

The responsible Committee on the Scottish Section of the Institution's Scheme of Education continues to carry out its onerous duties under the guidance of its Hon. Secretary. These duties are becoming more arduous each succeeding year, and the wonder is that the duties are so efficiently performed. It is gratifying to know of the painstaking efforts of many of our students, despite the fact that many of these young men are situated in places far removed from the large centres of technical education. But I have noticed, during my visits to the Scottish Education Meetings, that there are certain students who fail to grasp the value of becoming proficient in the ancillary subjects leading up to the more serious business of technical training. These young men are inclined to sidetrack the most important part of the Education Scheme—namely, the preparatory stage of Higher Grade Education—but it should be constantly impressed upon them that if they become proficient in the higher stages of English, Mathematics, Physics, and Chemistry, the work of technical training for the essential qualifications of first-class gas engineers will be made easier.

Coal Industry.

The outstanding problem of the present time is the increasing industrial depression which is affecting this country to the point of stagnation. This depression must eventually, if it continues, affect our own Industry. Indeed there are already reports of a slight set-back in output. But there are undertakings which are reporting increases that help to average out other less fortunate undertakings, so that it can truly be said that the Gas Industry, despite the trying conditions through which we are passing, is more than holding its own.

But one great problem of the present time is the position of the coal industry. That position has become so bad as to cause serious anxiety to all, particularly to politicians and industrialists. It is generally accepted that the pressing need of the coal industry at the moment is the need of a fresh outlook. I refer to this advisedly, because coal is so important to the Gas Industry. Without coal as a raw material our Industry could not exist. In what direction, then, are we to find that fresh outlook which will lift the coal industry out of the present state of stagnation? It is no part of my business to speak of the conditions which have led up to the present position, but I may be allowed to say that the adoption by the coal industry of a spirit of co-operation between employers and workmen for the welfare of the industry would, I am confident, have resulted in the all-round advantages which are accruing to other well-regulated industries. The damage has been done, and, in expressing this opinion, I am merely performing the duty of an individual who desires the well-being of all connected with such an important part of our national industrial fabric. May the time be near when the coal industry will again play its great part in our national prosperity.

During the post-war years there have been various processes evolved for the better utilization of coal, and one to which has been devoted much research and capital expenditure is that of low-temperature carbonization. While this has become technically and practically possible, it has been found to be economically unsound. Then there is the process of pulverization. This, for a time, held out some prospect of success, but it suffers from the disadvantage of causing excessive dust and ash during the process of combustion, so that, unless some method is devised of dealing with the clinker while in the fluid state, the process of pulverization of coal will not make much rapid progress.

The hydrogenation of coal is at the present time the subject of much research and is thought by some of our leading industries to be the best possible method yet evolved for the production of oil from coal if it can be produced cheap enough to meet competition from imported oil.

Lastly, there is the latest experimental use of colloidal fuel (a mixture of oil and pulverized coal), which is at present being tried by the Cunard Steam Ship Company.

The great drawback of all these processes for the better utilization of coal is the tremendous capital cost of plant required. Whatever may be the outcome of all this research and experimental work, only time and the efforts of the research workers can tell.

I have only referred briefly to the various processes which are under consideration for the more efficient and economical use of coal and the betterment of the coal industry itself. Let me express the hope that one of these processes may become successful, although it is difficult to imagine a synthetic process becoming successful enough to be able to compete against a naturally produced liquid fuel such as oil, even when allowance has to be made for the cost of transporting the oil thousands of miles across sea and land into our own country.

My view, therefore, is that the means of re-vitalizing the coal industry lies within the Gas Industry and the Coke Oven Industry in the production of gaseous fuel and solid smokeless fuel. The ideal behind the process of low-temperature carbonization has been to produce a smokeless fuel that will meet the requirements of smoke abatement. While it has been successful in introducing a fuel superior to raw coal without the emission of smoke, it has, unfortunately, been impossible up to now to produce it at a price equal to the value of coal to the consumer. The fact is that low-temperature carbonization suffers from the fundamental disadvantage that the temperature is low. This has two consequences. One is that the transfer of heat and the reactions are slow, and, therefore, the size of the plant for a given throughput must be greater than that necessary for high-temperature carbonization. The other, perhaps the more important, is that the yield of the most valuable product—gas—is correspondingly low. As a self-contained commercial enterprise on a large scale it must, for the present at any rate, be considered as dead. Any further developments in this direction should be placed in the care of experienced gas engineers.

Smoke Abatement.

The ideals of smoke abatement are being more fully realized year by year, and more especially by the industrial user. The mere fact that the emission of smoke creates waste and tends to inefficient and costly production is enough to turn the industrial user to more efficient methods of fuel consumption. This may be attained by the use of gas, coke, and oil for heat treatment, and, very often, oil and electricity for power production, so that we may confidently anticipate that soon the industrial user will no longer be accused of polluting the atmosphere by the burning of raw coal.

It seems to me, therefore, that the problem now to be faced is that of convincing the domestic consumer of his responsibility regarding smoke pollution of the atmosphere. It has to be admitted, of course, that the domestic consumer has realized to some extent his responsibility in smoke pollution, and this is proved by the increasing use of gas and electricity for the home requirements during the past twenty years.

The consumption of domestic coal has remained at a figure of 40 million tons for some years, despite the fact that thousands of houses have been built all over the country. This is a good indication of the fact that the domestic consumer is realizing the advantage of the increasing use of gas and, to some extent, of electricity. But for the complete utility requirements of the home, gas—and electricity to a much greater extent—is still too expensive. It is apparent that the use of coke must be more seriously developed if the maximum of smoke abatement is to be realized.

Coke can be said to be the cheapest form of smokeless fuel we have to-day, but the question is: How are we to induce the domestic consumer to use coke in preference to raw coal? The responsibility for answering this question lies, to some extent, with the carbonizing industry in the production of a better and more useful class of coke. In past years the hunt for increased yields of gas per ton of coal, while very desirable, has in some cases reduced the quality of coke, but this is a fault which might quite easily be overcome by a better selection and blending of coal. Too often, I think, the desire has been to obtain a low average price of coal, with the result that the quality of residual coke, irrespective of the gas produced, has not been all that might be desired. It has been my experience during past years to watch carefully the class of coal which gives

a good yield of gas and at the same time a good and useful quality of coke suitable for the requirements of the domestic consumer. To obtain this I have reduced to a low figure the number of different coals which will give that particular blend and a good quality of smokeless fuel, and I am of the opinion that what is being done to-day in some large undertakings in the production of smokeless fuel can be accomplished by the whole of the Gas Industry. It therefore goes without saying that, given a mandate for producing solid smokeless fuel and an assured and stable outlet for this commodity, the Gas Industry would obtain far richer benefits.

The responsibility for the further purification of the atmosphere in our big industrial cities lies to a great extent upon local authorities, because these authorities are the large producers of coal gas and coke. That responsibility could best be met by the various authorities utilizing smokeless fuel, produced in their own gas-works, for the elimination of smoke within their particular areas. Too often, in large cities, we see huge stocks of coke waiting for export at a price much below its actual value, while the use of this fuel in the area of its production would provide the very means for the realization of the ideal of smoke abatement. It seems to me that, before we can teach the consumer to appreciate the benefits to be derived from the use of smokeless fuel, there must be in operation some compelling necessity. This, I fear, will need to be in the form of penal legislation prohibiting the use of raw coal by domestic consumers. This is rather an extreme view to take, but drastic ills require drastic remedies. When it is realized that the idea of smoke abatement has been discussed for the past fifteen or twenty years, the results attained cannot be claimed as being proportionate to the amount of time and effort expended.

Should there arise a necessity to provide for the national requirements of smokeless fuel in the form of gas and coke, what is likely to be the position of the carbonizing industry, as foreseen from the present position in regard to the country's requirements of domestic fuel?

There are undertakings all over the country with carbonizing plant in reserve to the extent of 50 p.ct. of the actual requirements. All this spare plant could be brought into productive capacity, and so, if given reasonable time to equip itself with the capital required for the laying down of large-scale plant, the Gas Industry, in co-operation with the Coke Oven Industry, is the most natural, convenient, and competent organization for the shouldering of this responsibility. The great need of the present time being the wise application of useful capital, I suggest that the economical provision of the national requirement of smokeless fuel is the most fruitful source of employing capital, more especially when there is an assured return for the capital employed.

The benefits to be derived from the treatment of raw coal are many. First, there will be the general and all-round improvement of the atmospheric conditions of the large cities; and there would also be the improvement in the agricultural land lying round these cities for the increased production of home-grown agricultural products. Secondly, there would be increased output in our coalfields for home requirements, because we would no longer think of 40 tons of domestic coal, but of the increased quantity of the raw coal to be treated. Sir Richard Redmayne, in discussing the effect of treating domestic fuel by low-temperature carbonization, was of the opinion that the quantity would be increased by over 10 million tons. There would, of course, be an increased responsibility upon the coal industry to improve the present method of cleaning and grading coal. This is most important if the quality of the coke produced by the carbonizing industry is to be improved. Then there would be the added advantage of increased employment in our coalfields. That would considerably increase the purchasing power of the workers in the coal industry, which would, in turn, produce a most desirable all-round improvement in general trade. And, thirdly, the gas and coke oven industries would benefit to the extent of an assured outlet for the production of its smokeless fuel. This would affect the Gas Industry in a manner likely to assist in more economical working costs. If, as I have said, it were possible to obtain complete smoke abatement, one could visualize many things that would take place within our Industry under the foregoing conditions.

There is one outstanding point to be remembered, which is that there would likely be a slight handicap in the efforts for high yields of gas per unit of coal caused by attempts to produce a better class of coke. While this might at first seem to indicate a reduction in the return for gas produced, it would eventually be counterbalanced by an enhanced value returned for coke, so that in the end we should be no worse off. Then there would be the further advantage of undertakings being in the position of conforming to a more uniform standard of gas values. This is one of the problems which I have no doubt our experts will be called upon to consider in the near future, and there can be no doubt that a more uniform standard of gas values will be to the advantage of the Industry, to the makers of gas-consuming apparatus, and also to the consumer.

So, gentlemen, I have briefly stated my views on the general aspects of our Industry and on some of its important relationships. While I am confident that others are thinking on similar lines, I expect many are equally sincere in holding different opinions as to the best means of using the national coal resources for the betterment of all. It must be borne in mind that neither individual opinion nor individual interest, but ideas most likely to benefit the whole nation, are those we desire to prevail.

Although our Industry has had a fairly long history, it is still young and virile. Like other great and useful undertakings, ours sprang from humble origin. From the apparently small idea of that Ayrshire genius, William Murdoch, the nation now possesses the great asset of scientific gas production, an Industry with which we are proud to be associated.

The President Thanked.

Mr. A. S. Nisbet (Paisley) said that Mr. Harper's stimulating and invigorating address was bound to add to the debt of gratitude the Association already owed him. He had pleasure in moving that the thanks of the members should be extended to the President.

Mr. Lewis Bain (Cullen) seconded the vote, which was carried enthusiastically.

B.C.G.A. District Conference.

Sir Francis Goodenough, C.B.E., Executive Chairman of the British Commercial Gas Association, who was invited to speak, said he would like to remind the members of the North British Association that a district conference under the auspices of the B.C.G.A. had been arranged to be held at Dumbarton on Oct. 5. Dumbarton had been fixed as the venue of the conference for the reason that at the same time it was proposed to observe the centenary of gas in that town. A splendid programme had been prepared by his good friend Mr. James Bell, Gas Engineer at Dumbarton.

Papers and Discussions.

The following papers were read and discussed: "Calorific Values and their Relation to Working Results and Costs," by Mr. James Jamieson, Assistant Gas Engineer, Edinburgh, and "Concentrated Gas Liquor," by Mr. R. J. Philp, Gas-Works, North Berwick. The paper by Mr. Jamieson is published in the "Journal" to-day, together with a report of the discussion. Mr. Philp's contribution will appear in the "Journal" next week.

New Office-Bearers.

The Secretary (Mr. A. Kellock) announced that the report of the scrutineers showed that the following office-bearers had been elected for the ensuing session:

President.—A. S. Nisbet, Paisley.

Vice-Presidents.—Lewis Bain, Cullen (Senior); George Bruce, St. Andrews (Junior).

Council (two vacancies).—R. J. Philp, North Berwick; T. Royden, Uddingston.

The President said it afforded him great pleasure to welcome Mr. Nisbet as the new President of the North British Association.

The President-Elect said he had been authorized to say that his Town Council would regard it as a satisfaction and an honour if the members would arrange to visit Paisley for the September meeting next year.

The invitation to Paisley was accepted, and Mr. Nisbet was asked to convey the thanks of the members to his Gas Committee.

Presentation to President.

Mr. H. G. Ritchie (Falkirk) presented the Retiring President with the usual memento of his year of office—a replica in miniature of the Wm. Young memorial at Lugar.

Mr. Harper acknowledged the gift and remarked that his year of office had given him much pride and pleasure.

Vote of Thanks.

A comprehensive vote of thanks was proposed to the Provost, Magistrates, and Town Council of Ayr for their hospitality, to the readers of papers, to the scrutineers, and to the Secretary and Council, for the arrangements made in connection with the annual meeting.

The Secretary acknowledged the vote.

Calorific Values and their Relation to Working Results and Costs*

By JAMES JAMIESON, Edinburgh Corporation Gas Department.

PRELIMINARY.

When the Meeting of this Association was last held in Ayr in 1922 the controversy over high and low grade gas was prominently before us, and I recall the interesting discussion which took place on the subject. In view of the time which has elapsed, the unsettled state of the market for residual products, and the enforcement of the Gas Regulation Act, it is probably an opportune time to review the position and see how far low-grade gas has become popular, also how far the economies forecasted from the latitude allowed by the Act have materialized, and the effect which the change has had on the residual products available for sale.

As the subject is a fairly comprehensive one I propose to deal with it in three parts:

A.—Analysis of published results.
B.—Production of 500-B.Th.U. gas.
C.—Production of various qualities of gas.

In the subsequent notes references to low-grade gas should be taken to cover qualities below 450 B.Th.U.

A.—ANALYSIS OF PUBLISHED RESULTS.

Mr. Butterfield, one of the Gas Referees, in a recent paper, entitled "Ten Years of the Therm" ["JOURNAL" for March 2, 1932], pointed out that the sale of gas in this country, other than by the therm, is now limited to non-statutory undertakings, and those statutory undertakings which sell less than 20 million c.ft. per annum. The 705 undertakings operating under the Act supply fully 95 p.ct. of the total gas used and 95 p.ct. of this quantity falls into one or other of four categories or standards.

Sales of Gas in Great Britain at Different Declared Values.

[Extract from the "GAS JOURNAL"—March 2, 1932.]

Declared Calorific Value.	Allocated to Different Declared Values.	
	Undertakings.	Therms Sold.
B.Th U. per C.Ft.	P.Ct.	P.Ct.
400 and lower	3·85	1·0
410 to 430	7·65	2·80
440 to 460	29·50	14·45
465 to 480	22·20	29·10
490 to 510*	33·75	43·05
520 to 540	1·80	1·05
550 to 560	0·95	8·50
600	0·30	0·05

* Includes one at 511·8.

It will be noted from the above Table that only 3·8 p.ct. of the therms sold carry a declared value below 440 B.Th.U., while 43·05 p.ct. is associated with 500-B.Th.U. quality. From this and from other statements which have been published in the Technical Press, it would appear that there has been no stampede towards the general adoption of low-grade gas, and that is the more surprising as it was at one time seriously suggested that, to meet competition successfully and cheapen the selling price, a lowering of the heat value would be necessary. Let us look for the reason for this apparent rigid adherence to higher declarations. Of the 705 undertakings which have adopted the Gas Regulation Act, 113 undertakings submit their accounts for inclusion in the "Gas World" analysis. From an examination of these figures much interesting matter is available, and it occurred to me that from this source might be provided an explanation of the continued popularity of high-grade gas. At the outset it was realized that various factors, such as geographical location, &c., might affect the comparison; but at the same time it was felt that, in arriving at the calorific value to be declared, all factors influencing this—such as carbonizing plant, coals available, market value of residuals, &c.—would be taken into account, and that the figure decided upon would be the most economic and suitable for the area concerned. On this assumption fairly reliable data should be available on working results and costs of producing different grades of gas.

The net cost of gas into the holder, as shown in the "Gas World" analysis of accounts, can, I think, be accepted at least as a reliable indication of the efficiency of operation. I have therefore extracted the ten undertakings, both company and municipally owned, which return, for years 1930 and 1931 respectively, the lowest net costs of gas into holder, and alongside I have shown the calorific values supplied. Any undertakings purchasing gas in bulk have been omitted.

Name of Undertaking.	Gas Made in Therms. Per Annum.	Net Cost of Gas in the Holder. Pence per Therm.	Quality. B.Th U.
Coatbridge	1,490 072	1·98	475
Nottingham	14,781,293	2·37	475
Paisley*	3,050,945	2·47	500
Belfast†	19,642,175	2·51	460
Hamilton	1,322.778	2·64	440
Falkirk	1,559,885	2·65	430
Edinburgh	16,608,927	2·71	500
Carlisle*	2,705,373	2·76	450
Dumbarton	741.744	2·82	425
Leeds	14,918,453	2·83	470

* No Official Examiner appointed.
† Gas Regulation Act does not apply.

The range of calorific values included in the "Gas World" analysis varies from 400 B.Th.U. through 17 different declarations to 560 B.Th.U. The lowest net cost of gas into the holder—1·98d. per therm—is returned by Coatbridge, supplying 475-B.Th.U. gas, this being followed by Nottingham favouring a similar quality. Three only of these ten undertakings supply gas below 450 B.Th.U., although no fewer than 16 are included in the "Gas World" analysis of accounts. While it may not be safe to suggest that these figures prove that the cheapest therm can be produced at any particular calorific value, one must be impressed with the favourable position which undertakings making 500/475 B.Th.U. gas occupy, and there is certainly nothing to indicate that the forecasted economies from low-grade gas have materialized.

In an endeavour to discover the reason for this, I decided to make a more exhaustive examination on various qualities of gas—500, 475, 450, 425, and 400 B.Th.U. being selected. The four undertakings in each group in the "Gas World" analysis returning the lowest net cost of gas into the holder were taken, and the working results and manufacturing costs are shown in Statement No. 1. Undertakings purchasing bulk supplies have again been omitted, and where carburetted water gas is made and recorded separately it has been deducted in arriving at the therms produced per ton of coal carbonized.

THERMS MADE PER TON OF COAL CARBONIZED.

The highest make per ton—94·3 therms—is found in the group supplying 425-B.Th.U. gas, this being followed by 87·7 therms at 500 B.Th.U. But at 400 B.Th.U.—the lowest declaration—we find only 81·3 therms. The low yield for the four undertakings supplying 475 B.Th.U., when compared with the returns at 500 B.Th.U., is difficult to explain.

While the coal used plays an important part in the results obtained and may account to a great extent for the variations, nevertheless I would have expected a more consistent increase in the therms available per ton of coal treated as the quality falls than these figures indicate.

PRICE OF COAL.

As expected, the price of coal per ton varies considerably, and this is no doubt due to the geographical position of the works in relation to the coal fields, the cost of handling on the plant, and the grade of coal available. The cheapest price, 15s. 10·3d., is returned by an undertaking supplying gas of 400 B.Th.U., while the highest applies to a declared value of 450 B.Th.U. The cost of coal per therm sold is influenced by the number of therms produced per ton, and this is very clearly illustrated when one looks at the two undertakings producing the highest thermal yields, the cost of coal per therm being 2·99d. and 2·68d. respectively.

The lowest price per therm paid for coal is returned by the undertaking showing the lowest purchase price per ton, although the therms produced are slightly above the average.

Looking at the cost of coal less residuals, some very interesting figures arise. The lowest price, 0·65d. per therm, is returned by the undertaking producing the

* Paper read before the North British Association of Gas Managers, Sept. 8, 1932.

STATEMENT No. 1.—*Showing Working Results and Costs of Various Qualities of Gas.*

[Taken from "Gas World" Analysis of Accounts—Year 1931.]

Owner of Undertaking.	Declared Calorific Value.	Coal Gas Made.		Coal Carbonized. Cost per Ton.	Cost per Therm.	Cost per Therm, *less* Residuals.	Coke and Breeze. Sold per Ton.	Return per— Ton.	Therm.
	B.Th.U. per C.Ft.	Therms.	Therms per Ton.	s. d.	Pence.	Pence.	Cwt.	s. d.	Pence.
Motherwell	400	1,561,084	77·5	15 10·3	2·75	1·48	5·4	19 0·7	0·89
Halifax	400	4,008,632	81·3	19 5·0	3·06	1·53	12·1	11 11·5	1·14
Dumbarton	425	741,744	81·8	19 4·0	3·01	1·33	7·9	17 4·8	1·07
Nelson	425	2,321,306	94·3	23 2·4	2·99	1·71	10·3	14 0·7	0·93
Blackburn	425	4,597,828	84·5	22 0	3·38	1·95	9·4	14 11·2	1·07
Ellesmere Port	425	637,096	79·7	20 9·6	3·57	2·30	5·1	20 3·6	0·88
Carlisle	450	2,705,373	85·9	20 5·7	3·07	1·70	8·7	15 3·8	1·00
Tipton U.D.C.	450	1,025,478	86·6	23 2·4	3·42	1·65	7·4	21 3·1	1·17
Smethwick	450	3,844,322	85·3	23 7·2	3·39	1·59	9·1	22 2·8	1·46
Perth Corporation	450	1,743,930	67·6	20 2·4	3·98	1·85	8·8	17 8·6	1·52
Coatbridge	475	1,490,072	66·5	16 7·2	3·21	0·65	9·5	19 5·2	1·78
Nottingham	475	14,692,693	66·6	17 4·3	3·27	0·90	9·4	18 8·6	1·66
Widnes	475	1,921,195	63·4	16 7·6	3·37	1·15	11·2	15 9·1	1·79
Lancaster	475	1,902,969	72·3	20 7·2	3·59	1·78	9·0	18 5·2	1·45
Paisley	500	3,050,945	87·7	18 7·4	2·68	0·92	8·9	18 9·1	1·21
Edinburgh	500	16,314,927	74·7	18 7·6	3·08	1·50	8·9	16 6·2	1·21
Derby	500	9 065,589	66·6	18 8·6	3·39	1·52	10·1	15 1·9	1·39
Dewsbury	500	1,680,635	72·0	15 10·5	3·00	1·03	9·0	20 5·2	1·73

STATEMENT No. 1.—*Continued.*

Owner of Undertaking.	Tar. Sold per Ton.	Return per— 1000 Galls.	Therm.	Manufacturing Charges. Purification per Therm Sold.	Salaries per Therm Sold.	Wages per Therm Sold.	Maintenance per Therm Sold.	Net Cost into Gasholder per Therm Sold.	Type of Carbonizing Plant.
	Galls.	£ s. d.	Pence.	Pence.	Pence.	Pence.	Pence.	Pence.	
Motherwell	17·1	8 3 4·8	0·48	0·02	0·14	0·33	0·89	2·86	V.
Halifax	19·5	7 13 0	0·47	0·05	0·13	0·37	1·26	3·34	V.
Dumbarton	18·1	10 16 0*	0·61	0·04	0·30	0·82	0·33	2·82	V.
Nelson	17·2	8 2 7·2	0·36	0·13	0·07	0·37	1·18	3·46	V.
Blackburn	15·5	8 8 4·8	0·40	0·03	0·12	0·78	1·19	4·07	V.
Ellesmere Port	17·9	6 6 4·8	0·39	0·02	0·26	1·12	0·92	4·62	V.
Carlisle	15·1	8 3 4·8	0·37	0·10	0·20	0·25	0·51	2·76	V.
Tipton U.D.C.	18·2	10 9 2·4	0·56	0·03	0·10	0·40	0·90	3·08	V.
Smethwick	15·9	7 8 7·2	0·34	0·03	0·14	0·54	0·79	3·09	V.
Perth Corporation	15·1	8 12 7·2	0·51	0·01	0·15	0·35	1·10	3·46	V.
Coatbridge	19·4	8 6 4·8	0·62	0·01	0·10	0·78	0·44	1·98	V
Nottingham	12·5	14 6 2·4	0·67	0·01	0·09	0·40	0·97	2·37	H.I.V.
Widnes	6·9	9 15 2·4	0·27	0·13	0·21	0·39	0·96	2·84	H.
Lancaster	11·0	9 11 2·4*	0·36	0·01	0·21	0·36	0·62	2·98	I.
Paisley	18·7	8 1 7·2	0·43	0·04	0·15	0·45	0·91	2·47	V.
Edinburgh	14·7	7 10 0	0·36	0·03	0·06	0·23	0·89	2·71	V.
Derby	12·4	10 14 3	0·48	0·09	0·10	0·55	0·82	3·08	H.V.
Dewsbury	10·5	5 18 4·8	0·24	0·13	0·08	0·79	1·24	3·27	H.

* Includes ammonia.

second lowest thermal yield—66·5 therms per ton—and favouring a declared calorific value of 475 B.Th.U. It will also be observed that this undertaking has the lowest net cost of gas into the holder, which demonstrates the important part a favourable market for residuals has on the cost of production. The undertaking purchasing the cheapest coal produces ten therms more per ton and returns a net figure for coal of 1·48d. per therm, or more than double that shown for the former works.

Coke and Breeze Available for Sale.

The coke and breeze sold per ton of coal carbonized show wide variations difficult to explain. If we look at the two undertakings having declared values of 400 B.Th.U. we find returns of 5·4 cwt. and 12·1 cwt. of coke per ton of coal carbonized. While the coke required for works purposes is sure to vary and depends on the type of retort settings, steam required, &c., nevertheless these points alone could hardly account for such a wide difference. A similar disparity is shown in the group supplying 425-B.Th.U. gas. Above this we find much more consistency and returns more in keeping with what might be expected. The average price obtained per ton of coke and breeze has been arrived at by dividing the revenue received for coke and breeze by the quantity returned as being available for sale. Any conclusions drawn are dependent for their accuracy on the method of compilation, and it has been assumed that coke used in retort producers for steam raising and other works purposes has not been included in the total as being available for sale. The highest price—22s. 2·8d.—is found in the group of undertakings supplying 450-B.Th.U. gas, while the lowest figure—11s. 11·5d.—is returned by the undertaking declaring 400 B.Th.U. and having the large quantity of 12·1 cwt. available for sale. This would seem to indicate that the market for coke in the particular area is limited, or that there is some variation in the quantity returned, and used as the divisor in arriving at the price.

The return from coke and breeze per therm sold shows a much greater consistency than any of the previous results mentioned, particularly so for the groups from 450 B.Th.U. upwards; indeed, at 475 B.Th.U. the greatest difference between the highest figure, 1·79d., and the lowest, 1·45d., represents only 0·34d. per therm sold. The lowest rate—0·88d., is attached to the undertaking producing 425-B.Th.U. gas, 5·1 cwt. of coke, 79·7 therms, and obtaining 20s. 3·6d. per ton; while the highest price, 1·79d., is found in the group supplying 475-B.Th.U. gas, 11·2 cwt. of coke, 63·4 therms, and obtaining 15s. 9·1d. per ton.

Tar Available for Sale.

The quantity of tar available for sale shows many inconsistencies. The highest figure—19·5 gallons—is returned by the undertaking supplying 400-B.Th.U. gas, and this is what one might look for. The next highest, 19·4 gallons, is found in the group declaring 475-B.Th.U. gas,

and if it were not for the consistently low yield by the other undertakings in this group one might attribute this to low heats accompanied by low gaseous yield of gas per ton of coal carbonized. From an examination of the carbonizing plant in use, however, it will be noted that this particular undertaking is the only one in the group using vertical retorts entirely and this may explain the high yield available. The return of 18·7 gallons for one of the works producing 500-B.Th.U. gas is worthy of mention as it is accompanied by 87·7 therms per ton of coal carbonized, and when compared with 14·7 gallons, the next highest figure in this group, which returns only 74·7 therms, makes the return of that particular undertaking very difficult to explain.

The highest price per therm received for tar—0·67d.—is by the undertaking producing only 12·5 gallons, but having a low thermal yield of gas—66·6 therms at 475 B.Th.U.—while the lowest, 0·27d., is found in the same group returning 6·9 gallons, and producing 63·4 gaseous therms per ton of coal carbonized.

It will be observed from these various particulars how difficult it is to make comparisons without a knowledge of local conditions, and how misleading any conclusion come to might be without a thorough examination of the whole circumstances. But one important point emerges, and that is that in many cases high yields of gaseous therms are not the most profitable, and, in view of the larger yield of residuals at the higher declared values, I have no doubt this is the reason why the supply of low-grade gas has not become more popular.

Net Cost of Gas Into Holder.

While the former figures may be affected by the manner in which the various accounts analyzed have been allocated and arranged under the heading of net cost of gas, all factors affecting the position financially are brought into line, and a truer standard of comparison arrived at. The lowest price per therm for each group is as under:

	Pence per Therm.
475 B.Th.U.	1·98
500 ,,	2·47
450 ,,	2·76
425 ,,	2·82
400 ,,	2·86

It is of importance to note that the above costs all refer to undertakings in Scotland, treating Carlisle as being on the Border line. From this one might conclude that the most favourable declaration so far as net cost into the holder is concerned is between 475/500 B.Th.U.

I have endeavoured to use these returns in an unbiassed manner to see how far they can help us to arrive at the declaration at which the cheapest therm can be produced. While the assumptions made may be erroneous, and no doubt will be disputed, nevertheless I do seriously suggest that no case can be made out from them for the general adoption of gas below 450 B.Th.U., and maintain that, with efficient management and plant, reasonably high-quality gas can be produced as cheaply as low-grade gas, and the carrying capacity of the distribution system thereby advantaged.

B.—PRODUCTION OF 500-B.TH.U. GAS.

Carbonizing Development at Granton.

In 1902 the first section of the Granton Works was put to work, the second following in 1906. Both sections were equipped with inclined retorts, placing Edinburgh in the forefront with carbonizing plant; but the perfecting of vertical retorts so soon afterwards somewhat obscured the part played in Scotland in the retorting of coal by inclined settings. It is complimentary to the efficiency of the process, however, that it was not superseded until 1926, and then not on account of inefficient results, but owing to the fact that the benches required re-building, when the whole question had to be reviewed, keeping in mind provision for future developments.

The quality of gas produced was approximately 550 B.Th.U., and water gas was used for diluting to our standard quality of 500 B.Th.U. There is shown on Statement No. 2 the working results from this combination for the year 1924/25, this being the last full year the process operated. It will be observed that 75·1 therms per ton of coal carbonized were produced at 499·7 B.Th.U. For the manufacture of 500-B.Th.U. gas it did not appear that vertical retorts could better these results, and indeed this was confirmed when guarantees were received. The principal factor which decided the change was the demand from the Continent for coke having a high cubic measurement per ton, and with the characteristics of that produced in continuous vertical retorts. As approximately 50 p.ct. of our coke is exported, no alternative was available, and, while we realized the difficulties which confronted us with our declared value, we could not in any circumstances face a falling off in the demand for our coke on the Continent.

Vertical Retorts.

The first plant consisted of an installation of Woodall-Duckham retorts capable of carbonizing 752 tons of coal per day, and producing 11 million c.ft. of gas of 500 B.Th.U. quality. This plant was fully described in the Technical Press, September, 1926, so I need only briefly refer to it. It is arranged in two parallel benches each containing 11 standard settings of 4 retorts. These have a nominal capacity of 8½ tons of coal per day, and measure 25 ft. 6 in. long by 6 ft. 2⅜ in. by 8½ in. at the top, tapering to 6 ft. 6½ in. by 19 in. at the bottom. The retorts and combustion chambers are constructed of silica for a depth of approximately 17 ft. below the combustion chamber nostrils.

The plant was put to work in 1926, just prior to the general strike, and, before getting an opportunity to settle down on local coals, had to deal with the many and varied kinds purchased only in an emergency. During this period the declared quality of gas supplied was not so closely adhered to although every endeavour was made to keep it as near the standard as possible. With imported coals of unknown quality and the new verticals with their tendency for lower-grade gas, our troubles were aggravated, and it was difficult to estimate with any degree of accuracy how we would fare when normal conditions returned. Fortunately, in arranging our coal stocks we had allocated portions of the store to particular coals, instead of mixing haphazardly, and it was therefore known seams we were dealing with. It had also been customary for us to put on a properly paved floor, heaps for each coal contracted for, and to test a portion of this at frequent intervals to discover the amount of deterioration by weathering. This information was of immense value to us, and, while it did not supply a correction factor applicable to vertical retorts, it kept us right so far as the inclines were concerned.

From the results obtained in the inclined retorts, however, and comparing these with the figures from the verticals, taking into account the fact that stock coal was being used, it appeared that there were good grounds for fearing that our standard quality of 500 B.Th.U. would be difficult to maintain from the coals produced locally and from which a large proportion of our requirements are drawn.

With a portion of our inclined retorts working and producing gas of 550 B.Th.U. this transitionary period was not so serious as it might have been. Fortunately, however, with the introduction of the new vertical retorts a complete test plant was erected. One oven of 4 retorts, complete with producer, was arranged for, so that the gas could either go to the common foul main or through the test plant. The nominal capacity of the four retorts being 34 tons per day, it will be seen that results on a working scale were possible. The whole layout of this plant is an exact replica of the works plant, and was designed with the object of being able to test or experiment with any particular part of the process of manufacture. With this equipment we are not only in a position to provide the necessary data on which the value of a coal can be based, but we are also able to study its peculiarities and investigate the methods of adjustments required to obtain its maximum efficiency at any specific quality of gas desired.

Test Plant.

Steps were immediately taken to have this plant put to work, our object being to examine carefully each individual

Statement No. 2.—*Working Results of Inclined Retorts and Water Gas—Year Ended May* 15, 1925.

Plant.	Material Used. Tons.			Total Gas Made.		Average Calorific Value.	Gas Made per Ton.	
	Coal.	Coke.	Oil.	1000 C.Ft.	Therms.	B.Th.U.	C.Ft.	Therms.
Inclined retorts	185,943	..	..	2,182,626	12,101,215	554·4	11,738	65·08
Water gas	..	11,332	500	611,875	1,863,586	304·6	3,291	10·02
Totals	185,943	11,332	500	2,794,501	13,964,801	499·7	15,029	75·10

coal or mixture likely to assist us in retaining our declared value, or, if that were not possible, to discover the most economic value with the materials at our disposal. The results obtained were by no means what we anticipated; indeed, the opinions we had held were erroneous to a degree. The results of some of the many tests undertaken, and what was learned from these, were mentioned in my Presidential Address to the Waverley Association in July, 1929, so here I need only refer briefly to the findings so far as quality is concerned.

Many of the coals which were considered excellent for the inclined retorts had to be withdrawn, this withdrawal not being confined to the cheaper grades, high-priced qualities being equally affected. It was early apparent from the results that high quality of gas appeared to follow to some extent the caking index of the coal, but more particularly to the amount of smalls present in the mixture being carbonized; so we decided to investigate along these lines. Four coals, which individually gave calorific values of 477, 481, 485, and 491 B.Th.U. respectively, were selected. These coals had always been popular and eminently suitable for the inclined retorts, but when carbonized in the new verticals under the most favourable conditions produced gas deficient in quality to the extent of 20 B.Th.U. Here was a problem, and one which at first looked somewhat serious as large quantities were under contract and in every other respect the coals were satisfactory. A mixture of the four coals, single and double crushed, was put under test. The former produced a gas of 484 B.Th.U., and the latter 493 B.Th.U., the amount of smalls in the mixture being 29·9 p.ct. and 35·7 p.ct. respectively. The low calorific value from the individual coals was due to excessive formation of carbon monoxide, and from the results obtained it was concluded that with an increased amount of smalls in the coal being carbonized the surface available for the formation of steam cracking and water gas production is restricted, and also the denser bulk has a tendency to force the tar-laden gases towards the hot surface of the retort, thus fixing some of the tars as gaseous constituents. Double crushing of the coal and increasing the proportion of fines is probably a mechanical means of getting the same conditions in the retort with a non-caking coal as is present when a swelling coal is being carbonized. It may be suggested that, by reducing the percentage of steam, the formation of carbon monoxide might be limited, but with retorts of 8·5 tons capacity about 5 p.ct. of steam is necessary to maintain satisfactory working conditions at the bottom of the retort. It will be readily understood how the increased smalls would affect us financially in view of the lower price of breeze in comparison with coke; so it was decided to include in our mixture high-caking smalls and a proportion of Durham run-of-mine coal which could at that time be purchased at prices comparable with that of our local coals, and a mixture was arranged which limited to a large extent the amount of breeze in the residue and supplied on the average a gas complying with our declaration.

Our troubles, however, were not over. A further factor arising, and one which caused us considerable concern, was the variation in the quality of gas produced at different periods of the day. With constant conditions in continuous vertical retorts one expects fairly regular makes and calorific value, but with our mixture variations up to 30 B.Th.U. were occurring, and examination of plant and adjustments did not show any reason for this phenomenon. The records of our test plant were examined, and these showed the same variation, but less acute when sized coal free from smalls was used. It was, therefore, concluded that fines in the mixture played a part in this unusual behaviour of the plant. Ultimately it was found that as the material, which was a mixture of broken screened coal and caking smalls, was withdrawn from the hoppers, the movement of the bulk caused a sorting into sizes, the large coal going to the outward edges and the smalls remaining in the centre of the bulk. While the greatest care was exercised in elevating to ensure thorough mixing the result was defeated by the various sizes accommodating themselves according to the angle of repose. The same separation is apparent if one examines a bulk of any material of different sizes being stored and can be illustrated very clearly when storing or lifting unscreened coke from a bing.

I have plotted the variations on chart No. 1 for one coal elevation per day, and on No. 2 for two coal elevations, from which it will be seen that when the larger coal is carbonized the make of gas increases and calorific value falls, and *vice versa* when smalls only are available. This behaviour will not take place to the same extent when sized fuel is used, and I have no doubt this is one of the reasons why doubles and trebles are popular for vertical retorts. But this grade of coal, free from smalls, is not suitable for the efficient production of 500-B.Th.U. gas, and we have therefore actually discarded sized smalls larger than singles on this account. The difficulty was got over by elevating a portion of the coal at different periods throughout the 24 hours instead of the full day's requirements at one time, and this practically eliminated the variations which were taking place.

500-B.Th.U. Gas from Verticals.

Examination of the result of these experiments show how far they helped to solve our problem. Statements Nos. 3 and 5 show the working results and carbonizing costs for the full period that the first installation of vertical retorts have been in operation. It is worthy of note that the low yield per ton of coal carbonized of 66·5 and 68·1 therms at 495·2 and 493 B.Th.U. respectively during the first two years is followed by a consistent improvement until we reach the maximum figure of 77 therms of 502 B.Th.U., after which the plant was put down for examination and repair, having been in use for 2203 working days. During that period over 1·13 million tons of coal were carbonized, the average throughput being 8 tons 11 cwt. per retort, the highest figure for one year being 9 tons compared with a guarantee of 8·55 tons. The average yield per ton of coal carbonized is 73·4 therms at 498·7 B.Th.U., but this is due to the low return in the early years of the plant's life, the average for the last five years being 75·14 therms at 500·1 B.Th.U., compared with the guarantee of 72·5 therms at 500 B.Th.U. The average number of retorts at work throughout the period was 65, or 73·86 p.ct., this reduction being due to retorts having to be let down during summer months. Statement No. 4 shows the entire working results for a period covering 122 working days along with the guarantee figures, and it will be noted that in all cases, with the exception of steam produced, these have been exceeded. The calorific values quoted are the average of five spot tests daily and one test on a sample collected over 24 hours and are therefore representative. I am hopeful these figures will be further improved, and I see no reason why 80 therms should not be topped if the investigation at present under way materializes to the extent expected. In Statement No. 5 I have given a detail of carbonizing costs allocated under various headings. The highest item—0·205d. per 1000 c.ft. made—is for charging the retorts, this including all rodding and other top work; and it would appear that it is only under this heading we can look for any reduction in the costs. Probably at some future date it will be possible to rod mechanically, and this, in my opinion, would be a step in the right direction, as rodding plays no small part in the efficient production of gas of 500 B.Th.U. quality. We have found that increased rodding is accompanied with higher gaseous yields, and we employ more labour on this work than was suggested by the makers of the plant. Our average net cost of gas into the holder for year ended 1931, as shown by the "Gas World" analysis of accounts, was 2·71d. per therm, which compares favourably with the undertakings supplying a lower calorific value.

Official Examination of 500 B.Th.U. Gas.

Only four undertakings in Scotland using continuous vertical retorts have a declaration as high as 500 B.Th.U.—*i.e.*, Edinburgh, Aberdeen, Paisley, and Inverness. These undertakings supply 21·07 p.ct. of the total gas used in Scotland, a very significant proportion. Under the Gas Regulation Act the quality of gas in Edinburgh is examined twice per day at two of three testing stations available. No. 1 Station is situated at the Works, while the others are three and four miles respectively from the source of supply.

With average Scotch coal, when carbonized in continuous vertical retorts, 500 B.Th.U. is the highest figure which could be declared with safety. To produce gas of 498/500 B.Th.U. on the average presents no difficulty, but each unit above this is difficult to harness; indeed, from observations over a long period, using a wide range of coal, the collecting of the last units can account for a fall in the make per ton, equivalent to as much as three therms. When the supply is under examination it is not 500 B.Th.U. which has to be produced but a margin over this, and it is this margin which makes 500 B.Th.U. a very difficult declaration so far as gaseous yields are concerned.

Striving, however, for the maximum thermal production in any particular declaration has it compensations, but this is more marked when the declared value is in the region of the limit possible with the coals available, as the plant must be maintained and operated at the highest standard of efficiency, and on this account I have no doubt losses which might otherwise have remained unobserved have been discovered and rectified with beneficial and improved results.

Since Edinburgh is the only undertaking in Scotland with continuous vertical retorts supplying officially examined gas of 500 B.Th.U. quality, the results of our official tests since we adopted the Act may be of interest, and these I have shown in Statement No. 9. While the margin over the

declared value is in some cases small, on no occasion has there been cause for anxiety. It is interesting to note that the average of the tests taken at the works came out slightly lower than that of the other stations, but this we attribute partly to the supply pipe from which the gas for testing is taken not giving a representative sample of the bulk of gas made. The figures, however, clearly prove that gas of 500 B.Th.U. can be produced efficiently in continuous vertical retorts from average Scotch coal, and at the same time meet the most stringent conditions laid down by the Gas Regulation Act.

being necessary if a reasonably high thermal yield is to be obtained at 500 B.Th.U. quality. I have come to the conclusion, however, that it pays to employ high temperatures, and I am convinced that when high-class refractories are used high heats are little if any more detrimental than lower heats; indeed, from observation I have made over a long period I have come to the conclusion that refractories suffer more from variations than through high heats constantly applied.

Although the retorts have been operated constantly at high temperatures, the silica and fireclay walls show little

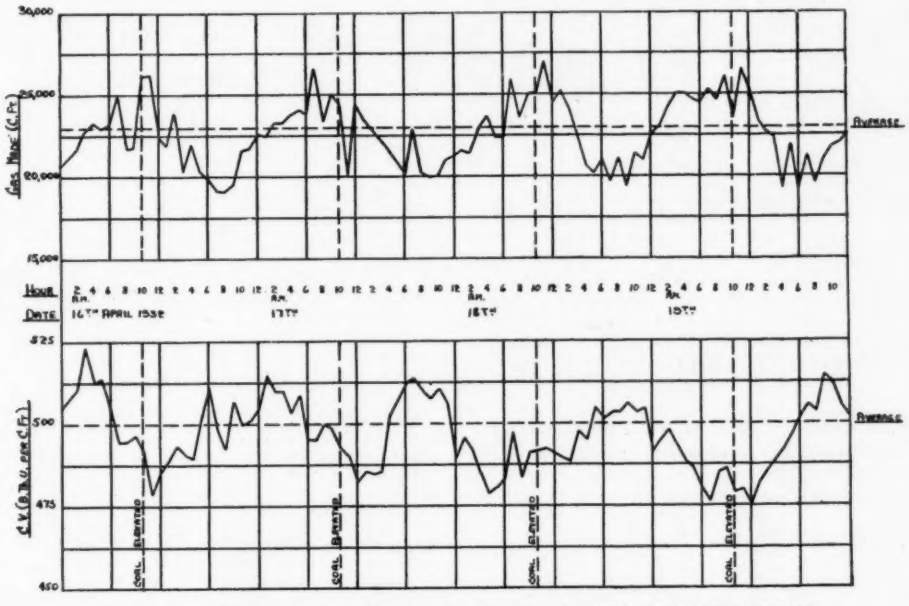


CHART 1.—SHOWING VARIATION IN MAKE OF GAS AND CALORIFIC VALUE.

One Coal Elevation per 24 Hours.

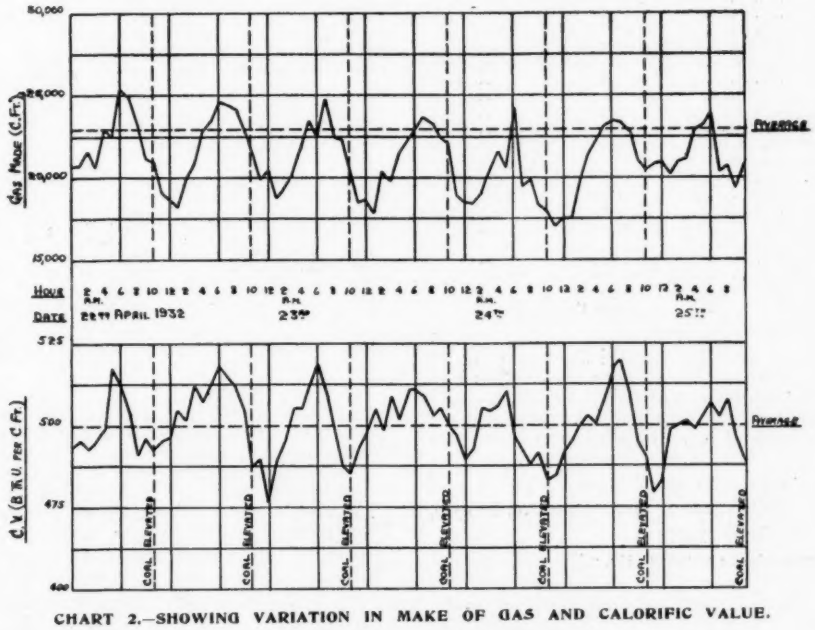


CHART 2.—SHOWING VARIATION IN MAKE OF GAS AND CALORIFIC VALUE.

Two Elevations of Coal per 24 Hours.

In order to provide these results it has been necessary to maintain fairly high temperatures in the combustion chambers, and the average over the period the retorts have worked was over 1400° C., while for long periods much higher heats have been carried. It was anticipated on this account that the cost of upkeep would be high, so a careful record has been kept of all labour and charges for materials, and this I have shown on Statement No. 6 at 8·36d. per ton of coal carbonized or 0·114d. per therm. This includes the services of a bricklayer and mate on each bench, who are constantly employed grouting and pointing, this sign of deterioration or wastage, apart from two courses at a point where the producer gas meets the secondary air in the combustion chamber, where spalling has taken place. This spalling appears to be a peculiarity of silica and is not common to one make or type, nor only to vertical retorts, as I understand horizontals constructed of this material are equally troublesome; it is an undoubted weakness in an otherwise very serviceable refractory. When we decided on verticals the first question which was considered was the estimated life of the retorts. It had been customary with the inclines to re-set 14 ovens each year, and in 1924

STATEMENT No. 3.—*Showing Working Results No. 1 (Woodall-Duckham Continuous Vertical Retorts) Section, From Feb. 2, 1926, to March 13, 1932.*

Period.	Days Working.	Coal Carbonized.		Total Gas Made.		Average Calorific Value.	Gas Made per Ton.		Average Number of Retorts Working.	Water Evaporated Waste Heat Boiler.
Year Ended.		Total.	Per Retort Working.	1000 C.Ft.	Therms.	B.Th.U.	C.Ft.	Therms.		1000 Galls.
		Tons.	Tons. Cwt.							
May 15, 1926	104	32,575	7 14	437,000	2,163,869	495·2	13,420	66·5	41	2,271
,, 1927	365	186,200	7 19	2,574,238	12,694,000	493	13,810	68·1	64	16,809
,, 1928	366	207,830	9 0	2,959,628	14,839,000	501·4	14,230	71·4	63	19,889
,, 1929	365	196,256	8 16	2,983,046	14,913,589	499·9	15,210	76·0	61	23,694
,, 1930	365	204,725	8 13	3,117,850	15,549,084	498·7	15,200	75·9	65	23,921
,, 1931	365	205,220	8 11	3,109,105	15,474,764	497·7	15,160	75·4	66	24,936
March 15, 1932	273	97,782	8 15	1,497,390	7,529,256	502·8	15,310	77·0	37	12,001
Total	2203	1,130,588	8 11	16,678,257	83,163,562	498·7	14,720	73·4	65	123,521
Results guaranteed.	..	..	8 11	..	..	500·0	14,500	72·5	..	..

NOTE.—The water evaporated in waste-heat boilers—123,521,000 galls.—represents a saving of 99,000 tons of boiler fuel, based on the evaporation obtained from direct-fired boilers of 5·57 lbs. of water per lb. of fuel consumed.

this cost £5980. As only small repairs were likely to be required on the new settings for some time we decided to inaugurate a suspense account and contribute to this £12,000 per annum. At the end of 1931 this had accumulated to £60,000 when the yearly contribution was reduced, as this sum was more than sufficient to re-set the two retort benches. While it was not absolutely necessary, we decided during the current year to re-build the top 10 ft. of one bench, as we felt that to delay, when the retorts had already worked over 2203 days, and only one bench could be done yearly, might occasion a risk which was not justifiable. as it meant we would have to work one bench approximately 3000 days, which, in my opinion, is too much to expect. This re-conditioned bench is now as good as new, and we anticipate should have the same working life as the new settings.

STATEMENT No. 4.—*Results of Test on No. 1 Installation of Woodall Duckham Verticals Compared with Guarantee Figures.*

—	—	Makers' Guarantee.
Duration, days	122	28
Coal carbonized, tons	54,692	..
Cannel coal	1·44 p.ct.	..
Average price per ton	17s. 11·36d.	..
,, ,, per 1000 c.ft.	14·36d.	..
,, ,, per therm	2·87d.	..
Gas made corrected, c.ft.	820,289,000	..
,, ,, therms	4,103,928	..
,, ,, per ton, c.ft.	14,998	14,500
,, ,, therms	75·04	72·5
Calorific value	500·3	500·0
Make per retort per day, c.ft.	132,083	123,975
,, ,, ,, therms	660·82	619·87
Throughput per retort per day, tons	8·8	8·55
Coke produced, tons	19,111	..
Breeze produced ,,	8,930	..
Unscreened coke for heating retorts, tons	7,220	..
Total coke and breeze produced, tons	35,261	..
Coke and breeze per ton of coal, cwts.	12·9	12·50
Coke used in producers per 100 lbs. of coal carbonized, lbs.	13·2	12·5 (dry)
Sulphate of ammonia per ton, lbs.	24·97	25·5
Tar per ton, galls.	14·86	14·25
Water evaporated waste-heat boilers, galls	7,636,671	..
,, ,, per ton of coal carbonized, lbs.	1,395	..
Water evaporated per hour, lbs.	26,030	28,215
Average temperature at inlet to boiler	1030° C.	..
,, ,, ,, outlet ,,	476° C.	..

STATEMENT No. 5.—*Showing Details of Carbonizing Costs on No. 1 Installation Woodall-Duckham Verticals from Feb. 2, 1926, to March 15, 1932.*

[For gas made see statement No. 3.]

—	Per 1000 C.Ft.	Per Therm.	Per Ton of Coal.
	Pence.	Pence.	Pence.
Superintendent and foremen	0·177	0·036	2·6
Coal men	0·096	0·019	1·4
Chargers	0·205	0·041	3·01
Dischargers	0·103	0·021	1·52
Producer men	0·133	0·027	1·95
Pipes, &c.	0·093	0·018	1·36
Scurfers	0·039	0·008	0·58
Coke handling	0·081	0·016	1·2
Generator attendants	0·044	0·009	0·644
Ash men	0·016	0·003	0·236
Engine men	0·108	0·022	1·58
Heating up retorts	0·009	0·002	0·135
Total pence	1·104	0·222	16·215

STATEMENT No. 6.—*Showing Cost of Repairs and Maintenance of Retort Settings Brickwork, Woodall-Duckham Continuous Vertical Retorts—Feb. 2, 1926, to March 15, 1932.*

—	Per 1000 C.Ft.	Per Therm.	Per Ton of Coal.
	Pence.	Pence.	Pence.
Labour	0·369	0·074	5·43
Materials	0·199	0·040	2·93
Total	0·568	0·114	8·36

With the utilization of the gravity-bucket elevators encircling each bench, which have to perform the dual purpose of handling the coal and coke from the retorts, it was felt that the cost of maintenance might be more expensive than if coal only were dealt with. So, having two elevators of similar size and design, we decided to keep a note of the cost of maintenance in order that a comparison could be made. This I have shown in Statement No. 7,

STATEMENT No. 7.—*Showing Cost of Repairs and Maintenance of Gravity Bucket Elevators—Feb. 2 1926, to March 15, 1932.*

—	A. and B.	C. and D.
Material handled	Coal and coke	Coke
Length of chain	510 ft. each	230 ft. each
Number of buckets	390 each	166 each
Coal handled	1,130,588 tons	..
Coke ,,	580,600 ,,	423,200 tons
Total ,,	1,711,188 ,,	423,200 ,,
Cost of maintenance per ton	0·715d.	1·3d.
,, ,, per 1000 ft. of chain	£1000	£1000
Weight handled per foot length of chain	3350 tons	1840 tons

from which it will be noted that the cost per 100 ft. length of chain for the conveyor doing the dual work is £1000, representing 0·715d. per ton of material handled, and for the other dealing with coke alone £1000, or 1·3d. per ton, which shows much in favour of the former.

Altogether the maintenance charges on this plant have been much lower than was anticipated, which I think is the highest compliment one can pay to the firm who erected it.

No. 2 Installation Vertical Retorts.

On account of the increased demand for gas and anticipating future requirements, we decided in 1930 to put down a second installation of continuous vertical retorts. This plant was inspected by the members of this Association at the Spring Meeting, and I propose only briefly to refer to it.

Messrs. Woodall-Duckham were again entrusted with the work, which consists of one bench of 44 retorts, each measuring 103 in. by 10 in. at the top, and 103 in. by 18 in. at the bottom by 27 ft. long. The retorts are heated by means of seven step-grate producers arranged in a separate battery. When all the retorts are at work producing 500 B.Th.U. gas, the plant is capable of carbonizing 533 tons of coal per day and is guaranteed to produce 14,500 c.ft. per

ton, or 72·5 therms. The plant differed from the previous one in that:

A.—External battery producers were adopted.

B.—The settings were non-recuperative.

C.—Larger retorts are provided.

D.—Facilities were provided for coal screening and blending.

E.—Vibrating coke screens were used.

F.—Belt conveyors were used where possible in place of G.B. push plate and trays.

I propose only to discuss headings A, B, and E, and compare the results obtained with the former plant.

Battery Producers and Non-Recuperative Settings.

However simply recuperators may be designed and however well constructed, they are always a possible source of trouble, and it will be agreed that they are only justified if they lead to a substantial saving in fuel.

Some calculations have been made, therefore, between the recuperative and non-recuperative settings at Granton. In each case the figures may be taken to represent the results obtained over long periods. The final figure is calculated in terms of net fuel consumption—*i.e.*, the coke charged to the producers less the coke equivalent to the steam made from the waste gas. As long as there is no excess of steam on the works this seems a fair method of expressing the value of these settings.

It will be noted, see Statement No. 8, that the recuperative setting gives a net fuel consumption of 8·3 p.ct. on the weight of coal charged, whereas the non-recuperative setting gives the very low figure of 4·7 p.ct.

Statement No. 8.—*Showing the Results of Recuperative and Non Recuperative Settings.*

—	No. 1 Installation.	No. 2 Installation.
Type of setting	Recuperative	Non-recuperative
Number of retorts	88	44
Size of retorts major axis	76 in.	103 in.
Nominal capacity, tons of coal per day	752	533
Coal carbonized per hour, lbs.	70,200	49,800
Dry coke used in producers—		
Lbs. per hour	8,775	6,298
Lbs. per ton of coal	280	283·3
P.ct. on weight of coal	12·5	12·65
Steam generated "from and at" 212° F.		
Lbs. per hour	28,215	38,010
Lbs. per ton of coal	900	1,710
Lbs. per lb. of dry coke charged to producers	3·23	6·04
Dry coke equivalent of steam raised (based on 9·6 lbs. steam "from and at" equivalent to 1 lb. of dry coke)—		
Lbs. per hour	2,939	3,960
Lbs. per ton of coal	93·8	178
Net fuel consumption to carbonize coal—		
Lbs. of dry coke per ton of coal	186·2	105·3
P.ct. on weight of coal	8·3	4·7

This lower fuel consumption is brought about in two directions. First, the brickwork in the non-recuperative settings including producers only amounts to 80 p.ct. of the volume of brickwork in recuperative settings. This has a favourable influence both on the radiation losses and incidentally on the capital cost. Secondly, the waste gases enter the waste-heat boiler at a higher temperature, with the result that the amount of steam generated per ton of coal carbonized increases from 900 lbs. with recuperative settings to 1710 lbs. with non-recuperative settings.

A still further advantage is that the non-recuperative settings give a lower pressure loss through the system, thus reducing to a minimum pressure differentials between the combustion flues and the retorts and saving fan power at the inlet of the waste-heat boilers.

Both from the point of view of ease of control of the plant and fuel conservation, our second installation has an advantage over the first installation by the concentration of the producers into one battery at ground floor level in place of the 22 separate producers in the former installation.

The many advantages of the battery type producers over a number of individual producers are as follows:

(1) Any given retort is not dependent on the condition of a particular fire. All the producers in the battery feed into a common distribution main which in turn feeds all the retorts.

(2) Any one producer in the battery may thus be let down and re-lined without in any way affecting the gas supply to any retort in the bench. Gas enters the setting almost free from dust, the dust coming out in the common producer gas main.

(3) By keeping a constant and predetermined pressure on the CO distributing main, steady heats can be maintained throughout the whole installation, irrespective of the condition of any one fire, and irrespective of fire cleaning, &c.

Our battery of producers has responded almost perfectly to the demands made for gas supply. Gas made has been varied at will by alteration of steam pressure and primary air, while at no time has the cleaning of the fires been arduous.

Cleaning is carried out every eight hours and the typical producer gas composition is—

CO_2	2·1
CO	32·6
H_2	10·3
N_2	54·2
CH_4	0·8
	100·0

It will be agreed that this is an exceptionally good composition for producer gas from step-grate producers and may be attributed to the design of the producer, which gives ample grate area, a correct depth of fuel bed, and a constant and easily controllable air steam ratio.

Coke Screens.

Since the question of coke grading is of so much importance probably the results of some tests undertaken recently in coke screens might not be out of place, and I have

Statement No. 9.—*Showing Average Quarterly Results of Gas Examiner's Tests, also Highest and Lowest Individual Tests.*

Year.	Quarter Ended.	Number of Tests Made at each Station per Quarter.				Average C.V. at each Station over Each Quarter.				Highest and Lowest Individual Test.					
						No. 1.				No. 1.		No. 2.		No. 3.	
		No. 1.	No. 2.	No. 3.	Total.	No. 1.	No. 2.	No. 3.	Average.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1927	June 30*	57	57	..	114	500·8	501·4	..	501·1	511·8	488·2	512·1	491·6	..	..
,,	Sep. 30	48	72	64	184	498·4	500·6	501·6	500·4	507·7	489·2	507·7	492·6	518·6	488·7
,,	Dec. 31	48	56	80	184	496·8	502·1	501·1	500·3	507·7	484·6	513·2	491·9	512·1	486·7
1928	Mar. 31	47	51	84	182	499·1	502·3	500·1	500·5	510·5	491·6	510·9	493·1	510·7	492·5
,,	June 30	47	52	83	182	498·8	503·2	500·2	500·7	509 9	486·9	514·9	497·7	510·5	490·8
,,	Sep. 30	47	53	84	184	500·1	500·0	500·3	500·2	505·5	493·0	510·8	494·4	511·9	493·2
,,	Dec. 31	47	50	87	184	499·0	502·7	499·4	500·2	508·3	491·5	511·9	490·1	511·7	491·3
1929	Mar. 31	46	50	84	180	498·4	501·8	500·0	500·1	509·0	491·9	508·9	496·3	508·2	492·0
,,	June 30	48	50	84	182	499·2	501·9	499·7	500·2	506·6	491·9	511·5	490·4	509·7	489·2
,,	Sep. 30	47	52	85	184	497·9	501·6	500·7	500·2	505·0	490·5	510·6	494·8	513·3	491·9
,,	Dec. 31	49	51	84	184	498·9	501·3	500·8	500·4	508·8	489·9	509·8	491·7	509·8	494·5
1930	Mar. 31	47	49	84	180	499·4	499·7	501·2	500·3	510·6	487·8	511·0	492·3	510·2	492·2
,,	June 30	48	54	80	182	499·0	500·3	500·8	500·2	507·7	490·3	508·8	493·9	508·5	490·7
,,	Sep. 30	45	56	83	184	498·1	500·7	501·2	500·3	507·2	489·6	514·0	488·3	510·2	493·9
,,	Dec. 31	47	54	83	184	497·4	500·0	501·6	500·1	508·5	488·6	506·2	489·8	509·4	492·0
1931	Mar. 31	45	58	77	180	499·9	500·6	500·0	500·2	510·2	488·9	520·8	490·0	510·3	490·6
,,	June 30	46	53	83	182	500·7	501·5	499·0	500·2	513·2	492·3	513·2	495·5	513·8	489·1
,,	Sep. 30	56	43	85	184	501·0	501·5	499·7	500·5	508·0	490·6	507·1	493·8	509·1	484·9
,,	Dec. 31	55	44	85	184	499·9	501·4	500·0	500·3	508·8	490·2	511·1	489·8	517·6	489·1
1932	Mar. 31	49	51	82	182	500·0	502·2	499·3	500·3	508·5	490·1	510·6	496·6	506·0	491·3

* Commenced May 5.

No. 1 Station—Granton gas-works. No. 2 Station—Glenogle Road, 3 miles from works. No. 3 Station—City Chambers, 4 miles from works.

shown the results on Statement No. 12. The efficiency was arrived at on the basis of "under size material screened out" in relation to "under size material in feed." The percentage of the various grades shown is the actual results of the separation which took place, and the efficiency obtained by comparing with hand-screening using a similar size and type of mesh. A certain proportion of breakage would result on this account, but, since it was common to all tests, can be ignored.

Tests A, B, C, and D are comparable, and it will be seen that the highest efficiency, 80 p.ct., was obtained in test A, and the lowest, 48 p.ct., in test D.

The following is a brief description of the screens:

A.—This screen has two flat screening units one above the other, the top deck having a larger mesh than the bottom one.

The coke is fed on to the upper screen where the larger sizes are removed, the remainder passing through, to be finally dealt with on the under deck, the breeze below $\frac{7}{8}$ in. passing direct into the storage hopper. Both decks are erected on a common frame which is vibrated by an eccentric connecting rod which is adjustable.

B.—This screen consists of a flat wire mesh vibrated by an electric solenoid. The amplitude of vibrations can be varied, but the number is constant at 15 per second. The solenoid is attached to the centre of the mesh and the frame is stationary, the amplitude varying from maximum at centre to minimum at sides of the screen.

C.—This screen consists of a single wire mesh held in a frame which is mechanically vibrated by an eccentric rod. The amplitude can be varied while the screen is working.

D.—Rotary type.

E.—Static screen fixed at an angle over which the coke falls by gravity. The steepness of the angle probably explains the low efficiency.

C.—PRODUCTION OF VARIOUS QUALITIES OF GAS.

The Coke Position.

I have already mentioned the part which coke plays in the economic production of high-quality gas, and in view of the market position this factor is causing most of us concern. One must not lose sight of the fact that in recent years there has been a surplus of coke in the market, and while we have increased our land sale trade with the improved efficiency of the vertical retorts, we have additional quantities available for disposal. This question of surplus residue was brought prominently to my notice recently by particulars obtained from 12 undertakings in different parts of the country, see Statement No. 10. Only one of these concerns is able to dispose of its entire production locally, and it will be noted that the average consumption of coke per annum per gas consumer is 8·09 cwt., and per head of population 2·39 cwt. With the increased competition from oven coke this is a somewhat serious matter, and the position is sure to become acute unless more can be used for domestic purposes—but price is a factor.

Statement No. 10.—*Showing Proportion of Coke Sold Locally by Various Undertakings.*

Undertaking.	Per Head of Population.	Per Gas Consumer.	P.Ct. of Total Sold Locally.
	Cwt.	Cwt.	
A	..	..	65
B	3·25	11·5	74
C	2·25	7	51
D	..	..	35
E	5	16	75
F	3·27	11·15	63
G	3	9·5	57
H	2	9	60
I	1·5	4·5	42
J	2·5	8·7	62
K	3·9	13·7	100
Edinburgh	2	6	50
Average	2·39	8·09	..

Under present conditions it is impossible to stabilize prices in view of delil erate dumping at uneconomic figures. While coke ovens may be the principal offenders in this direction, I am sorry to say the Gas Industry is not free from blame. Gas-works coke was railed into Edinburgh during last winter at a price which did not leave the seller more than 11s. per ton at the particular works from which it was despatched—surely unwarranted behaviour. The dumping, however, is not confined to these far distant works, many close neighbours being among the worst offenders. The result of this undercutting and dumping has meant reduced prices in Edinburgh—not in itself a bad policy, as it brings it more into line with that of coal, its chief competitor. But what I cannot follow is the reasoning behind an undertaking charging the artificial price of 27s. per ton for local sales and dumping the excess into areas already fully supplied. Would a better and saner policy not be to reduce the high local figure with the view of encouraging the greater use of coke in the particular area? And if only the same average price were obtained the whole Industry would benefit from the extended market. Dumping can never improve the position; indeed, it can only spell ruin. I am satisfied, however, that the price of coke is in the downward direction, and, while our works price is still 18s. 6d. per ton, I have a feeling a further reduction may be necessary before the winter is far under way. Should this be a correct forecast, the whole question of our declared value will require to be reviewed.

Production of Various Grades of Gas.

With this object in view we have recently undertaken a very comprehensive series of tests, producing gas of various qualities to enable us to focus the position. The results of these tests are given in Statement No. 11. Before commencing the work all instruments, apparatus, and plant were carefully calibrated and certified so that the figures would be as accurate as possible. Five different qualities of gas were selected from 500 B.Th.U. stepped down by stages of 25 B.Th.U. to 400 B.Th.U. A mixture of three screened coals used extensively in the Gas Industry was selected, not an expensive one, the average price being 17s. 5d. per ton delivered, but which was known to give a reasonable thermal production of gas of 500 B.Th.U. quality. The object aimed at was to get the highest make per ton consistent with the makers' guarantee of throughput per retort at the various calorific values. The plant was operated under usual working conditions, and the tests with the exception of No. 2 were over a period of 96 hours. A maximum of 141·64 tons of coal was treated so that it may be assumed the results are in keeping with working conditions. Preparatory to the test a run was made producing gas of 500 B.Th.U. quality, and this was compared with the returns from the Works, and the figures were remarkably close, so much so that we concluded that what was obtained in test might reasonably be expected under ordinary working conditions. Let us see how the results compare with the average returns shown on Statement No. 1, or how they can help us to arrive at the quality at which the cheapest therm can be produced.

Coal Carbonized.

It has already been mentioned that 141·64 tons of coal were carbonized producing gas of 500 B.Th.U. quality, representing a throughput per retort of 8·85 tons against a guaranteed figure of 8·55 tons. At 450 B.Th.U. the throughput dropped to 111·14 tons, or 6·95 tons per retort, and at 400 the results were 93·46 tons and 5·84 tons carbonized per unit, a reduction of approximately 34 p.ct. in carbonizing capacity, between the highest and lowest values.

Gas Made.

The quantity of gas made at 500 B.Th.U. was 2,292,444 c.ft.; at 450 B.Th.U. 2,654,038; and at 400 B.Th.U. 2,860,189 c.ft.; in therms equal to 11,483·4, 11,947·8, and 11,463·8 respectively. The gas made per ton of coal carbonized shows a very consistent rise as the quality falls. At 500 B.Th.U. we have 16,185 c.ft., or 81·08 therms; at 450 B.Th.U., 23,880 c.ft., or 107·5 therms; while at 400 B.Th.U. the return is 30,603 c.ft., representing 122·66 therms, or an increase of 41·58 therms, or 51·53 p.ct. in favour of the lowest declaration. This is what one might expect from a fall in the calorific value, and it makes it very difficult to explain the low yields returned in Statement No. 1 for the lower qualities, particularly when it will be observed that at 500 B.Th.U. these specially selected coals do not give more than four therms per ton above the average for the working period of our works plant up to March 15, shown on Statement No. 3.

The make of gas per retort in c.ft. shows a fairly steady rise as the quality lowers, but on the therm basis at 500 B.Th.U. we have 717·7; at 450 B.Th.U. 746·7; and at 400 B.Th.U. 716·5 therms, the balance being in favour of the 450 B.Th.U. declaration. The calorific value of the gas was arrived at by taking one test every hour throughout the entire period of the test, and in addition one collected samples per shift and per 24 hours. In addition to this, a calibrated "Sigma" B.Th.U. recorder was used, and the charts for each test are available for inspection.

The continuous record was ignored in arriving at the average calorific value, the daily average of 24 spot and 4 collected samples being used. The sample for gas analysis was taken from the quantity collected over 24 hours, and the average of each day's result is given. While the calculated calorific value in each case compares approxi-

STATEMENT No. 11.—*Showing Results of Producing Different Grades of Gas, also Two Tests with 20 and 10 P.Ct. of Second-Class Durham Coal added to the Mixture.*

[The results shown are the average of each day's return.]

	500 B.Th.U.	475 B.Th U.	450 B.Th.U.	425 B. Th.U.	400 B.Th U.	500 B Th U. Percentage of Durham Coal.	
						20 P Ct	10 P Ct.
Test No.	1	2	3	4	5	6	7
Class of coal	C W.N.	C W.N.	C W.N.	C W N.	C.W N.	..	..
Average price per ton	17s. 5d.	17s 5d.	17s 5d	17s 5d	17s 5d.	..	..
Duration of test in hours	96	72	96	96	96	96	96
Coal carbonized in tons	141·64	91·29	111·14	100·32	93·46	142·98	137·98
Throughput per retort in tons	8·85	7·61	6·95	6·27	5·84	8·94	8·62
Gas made, c ft.	2,292 444	1,807,388	2,654,038	2,790,805	2,860.189	2 205 191	2,190 887
,, therms	11,483·4	8,591·7	11,947·8	11,882·7	11,463·8	11,042·3	10,961·0
,, per ton, c ft.	16,185	19,798	23,880	27,819	30 603	15 423	15,888
,, ,, therms	81·08	94·12	107·5	118·45	122·66	77·23	79·49
,, per retort, c ft.	143 278	150,618	165 877	174 425	178 762	137 824	136 931
,, ,, therms.	717·7	717·0	746·7	742·7	716·5	690·1	685·1
Calorific value	500·9	475·4	450·2	425·8	400·6	500·7	500·3
Coke per ton in cwt	8·62	8·26	7·59	6·51	6·34	9·60	9·56
Breeze ,, ,,	3·25	3·68	3·30	3·61	3·76	2·50	2·73
Total coke and breeze per ton in cwt.	11·87	11·94	10·89	10·12	10·10	12·10	12·29
,, ,, ,, dry	11·09	11·14	10·02	9·09	8·91	11·07	11·55
Coke used per 100 lbs. coal	12·51	13·02	13·52	14·27	17·39	12·54	13·66
,, ,, ,, dry	11·88	12·57	12·81	13·15	16·04	11·61	13·02
Tar per ton in galls.	18·76	24·8	27·3	28·9	31·4	19·6	20·09
Liquor ,, ,,	49·9	49·7	54·6	62·8	77·6	52·7	53·7
Percentage of NH_3, fixed	0·066	0·054	0·062	0·054	0·050	0·17	0·044
,, ,, free	1·294	1·243	1·004	0·983	0·822	0·94	1·07
Total ,, ,,	1·360	1·297	1·066	1·037	0·872	1·11	1·114
Temperature of retorts, top	1,380° C.	1,388° C.	1,386° C.	1,386° C.	1,410° C.	1,392° C.	1,390° C.
,, ,, bottom	1,177° C.	1,191° C.	1,194° C.	1,173° C.	1,146° C.	1,148° C.	1,144° C.
Steam p.ct. weight on coal	12·33	18·44	27·29	43·81	58·99	12·66	13·04
Analysis of gas—CO_2	3·09	3·24	3·73	4·37	5·47	3·68	3·58
C_nH_m	2·91	2·20	2·24	1·95	1·67	2·74	2·96
O_2	0·08	0·15	0·22	0·15	0·22	0·08	0·14
CO	18·63	21·26	23·73	26·22	26·69	17·44	16·91
CH_4	19·87	17·19	15·99	13·08	11·19	20·19	19·64
H_2	48·53	48·79	46·90	46·22	46·44	48·74	50·16
N	6·89	7·17	7·19	8·01	8·32	7·13	6·61
Coal analysis—							
Moisture	7·87	8·00	8·21	7·77	7·24	7·56	8·27
Volatile	33·53	32·75	32·89	32·88	32·91	31·59	32·33
Carbon	51·20	51·70	51·85	52·85	53·75	52·95	52·30
Ash	7·40	7·55	7·05	6·50	6·10	7·90	7·10
Coking index of coal	1	1	1	1	1	3½	2
Coal Grading—							
P.ct on 2 in.	30·6	34·4	36·1	43·9	40·0	29·6	38·0
1½ in.	19·0	14·7	15·5	19·7	19·4	15·1	17·2
1 in.	20·4	17·5	18·1	15·9	16·9	14·4	16·7
¾ in.	6·5	7·3	6·1	5·7	5·1	6·7	4·8
Through ¾ in.	23·5	26·1	24·2	14·8	18·6	34·2	23·3
Analysis of unscreened coke—							
Moisture	2·25	1·14	5·18	8·08	14·95	2·70	2·73
Volatile	2·23	1·96	2·10	2·22	2·45	1·94	1·87
Carbon	85·44	87·18	79·33	75·63	69·65	84·36	84·72
Ash	10·08	9·72	13·39	14·07	12·95	11·00	10·68
Coke grading—Test A—							
P.ct. on 2 in.	20·5	20·3	17·1	14·4	13·9	27·6	21·3
1½ in.	24·6	25·4	19·1	17·6	17·7	23·2	20·2
1 in.	32·9	30·8	35·3	34·3	38·3	26·8	31·9
¾ in.	9·1	9·6	12·0	12·7	13·2	8·6	10·9
Through ¾ in.	12·9	13·9	16·5	21·0	16·9	13·8	15·7
Analysis of coke screened—							
Moisture	2·63	4·10	5·59	7·93	7·72	6·72	4·64
Volatile	2·01	2·10	2·16	2·24	2·14	2·32	2·18
Carbon	87·72	85·88	82·99	77·16	79·80	82·36	84·54
Ash	7·64	7·92	9·26	12·67	10·34	8·60	8·64
Analysis of breeze—							
Moisture	13·38	12·66	13·30	14·54	18·81	15·39	10·10
Volatile	2·46	2·93	2·77	2·86	2·93	2·85	2·82
Carbon	73·15	72·46	70·04	70·91	67·45	69·66	75·70
Ash	11·01	11·95	13·89	11·69	10·81	12·10	11·38
Coke grading—Test B—							
	O. Q. L.	C. Q. L.	C. Q. L.	C. Q. L.	C. Q. L.	C. Q. L.	C Q. L.
Quantity	37 2 14	30 1 11	23 3 21	23 0 1	16 2 25	36 1 12	38 0 12
P.ct. on 2 in.	12·4	7·2	11·1	4·9	5·2	25·2	29·4
1½ in.	31·3	24·8	27·1	22·7	18·3	20·4	23·1
1 in.	29·3	41·2	29·5	36·9	38·4	24·4	23·7
¾ in.	8·8	8·2	9·2	6·6	11·5	10·3	6·6
Through ¾ in.	17·4	18·6	22·1	27·8	25·1	19·1	16·9
Stones	0·8	..	1·0	1·1	1·5	0·6	0·3

mately with the actual, nevertheless it was felt that it was possible in view of the averaging that a discrepancy might arise, and probably a more representative figure might have been obtained had a continuous sample over the 96 hours been collected; but the difficulty in obtaining a suitable holder prevented this being done. On the whole, however, I am fairly satisfied with the figures, and I think they can be accepted as being representative of the bulk. At 500 B.Th.U. the CO_2 content is 3·09 p.ct., rising to 3·73 p.ct. at 450 B.Th.U., and 5·47 p.ct. at 400 B.Th.U. The percentage of hydrocarbons and CH_4 content falls with the quality, while the CO increases, the hydrogen remaining fairly constant. The low percentage of CO_2 and the high CO content indicate fairly good steam reaction, but one would have expected less consistency in the percentage of hydrogen found in the various grades, due to the formation of water gas. The nitrogen content is slightly on the high side for all tests at 500 B.Th.U., being 6·89 p.ct. rising to 8·32 p.ct. for the lowest value. This may be due particularly in the lower ranges to the admission of air with the large volume of steam used. The total inerts at the various qualities are 10·06 p.ct., 11·56 p.ct., 11·14 p.ct., 12·53 p.ct., and 14·01 p.ct. respectively, and are fairly reasonable, closely resembling the figures which I have obtained from gases of similar qualities supplied in other parts of the country. I have shown the quantities of the various constituents in the gas in chart No. 3.

While on the subject of gas analysis we might look at the retort temperatures. The figures given are the average of 4 daily readings taken at stated intervals throughout the period of test, the observations being taken at the same time each day. The producer cleaning routine was also standardized to avoid variations. It will be observed that the temperature at the top of the retort was maintained fairly consistently, but for the test at 400 B.Th.U. a slightly higher figure is recorded. This was necessary in

order to maintain reasonably good steaming conditions at the bottom of the retorts; but in view of the high percentage of steam being used—58·99 p.t. of the weight of coal—considerable difficulty was encountered in maintaining the heat, and a supplementary supply of CO had to be arranged to get over this; and from the CO_2 content of the gas I think it can be concluded it was satisfactorily accomplished. The increased percentage of steam used at the various qualities is worthy of note, 12·33 p.ct. being used at 500 B.Th.U., rising to 27·29 p.ct. at 450 B.Th.U., and to the high figure of 58·99 p.ct., already mentioned, for the lowest grade of gas made.

Coke and Breeze.

I have shown the quantity of coke and breeze separately, the size of mesh used for separation being ¾ in. square. As the calorific value of the gas drops, the quantity of coke and breeze produced falls. At 500 B.Th.U. we have on the dry basis 11·09 cwt.; at 450 B.Th.U., 10·02 cwt.; and at 400 B.Th.U., 8·91 cwt. The quantity produced at each successive stage declines consistently and is what might be looked for in view of a minimum of 15·6 lbs. of carbon being required per 1000 c.ft. of water gas produced. It will be observed that I have given the analysis of the unscreened coke and in addition the figures for the screened coke and breeze. The former shows that the moisture content varied very considerably and is returned at 2·25 p.ct., 5·18 p.ct., 14·95 p.ct., for 500, 450, and 400 B.Th.U. gas respectively. This increase in moisture content appears to follow the quantity of steam used. The volatile matter remains fairly steady, but one would have expected to find it lowest at the stage where the maximum gaseous yield was obtained. The ash content varies slightly, and it will be noted the highest figure, 13·39 p.ct., is returned for 450 B.Th.U. quality, whereas at 500 and 400 B.Th.U. we find 10·08 p.ct. and 12·95 p.ct. respectively.

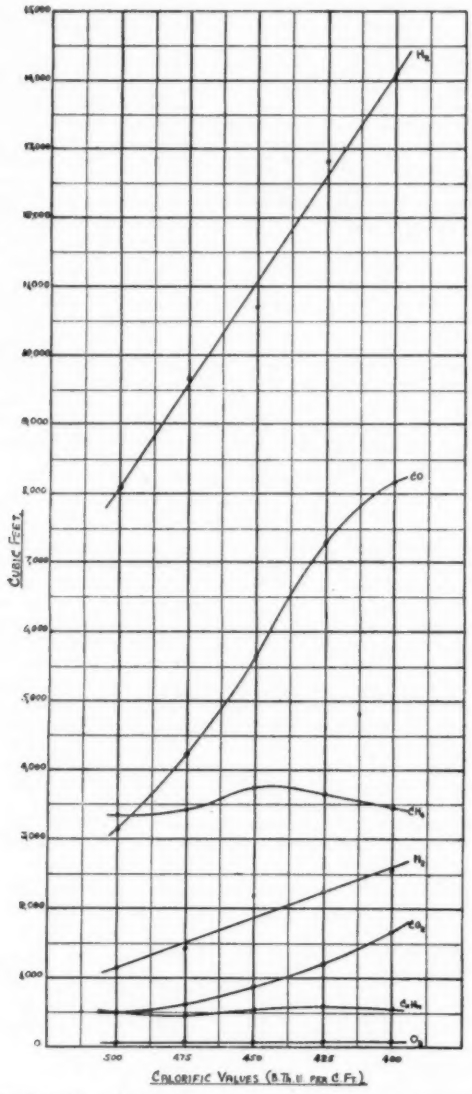


Chart 3.—Showing Quantity of each Constituent in Various Qualities of Gas.

The sample from which these results were obtained was collected by taking a small measured quantity over the 24 hours from each retort as it was being discharged at two hourly intervals, and this was the following day mixed and quartered until about 1 cwt. was available, this being ground and the quantity for analysis taken. Every effort was made to prevent loss of moisture through air drying, and sealed tins were used for the purpose. This sample was graded, and the results are shown in Test A, Statement No. 11, from which it will be observed that as the quality of gas was reduced the size of coke diminished, although the percentage of smalls in the coal used was much in favour of the lower values. Looking at this briefly we find in the coal used, 1 in. and above in size for 500 B.Th.U., 450, and 400 respectively, 70 p.ct., 69·7 p.ct., and 76·3 p.ct., whereas in the coke produced we get 78 p.ct., 71·5 p.ct., and 69·9 p.ct. If we also look at the smalls it will be seen that in the coal used we have 23·5 p.ct., 24·2 p.ct., and 18·6 p.ct. passing through a ¾ in. mesh, and in the coke 12·9 p.ct., 16·5 p.ct., and 16·9 p.ct. for the three grades mentioned above. These results are plotted in chart No. 4. This would seem to indicate that steaming has an effect on the caking power of coals or has a tendency to cause a disintegration of the material itself, due to the action of the steam in forming water gas. As already mentioned, the coke and breeze were separated and each portion analyzed, and for this purpose a complete two hourly draw from the four retorts was taken, this quantity being graded and sampled for analysis. In view of the larger amount of material available, it was felt that the results of this grading would be more representative, and these are shown on grading test B, Statement No. 11, and confirm the former results. At 500 B.Th.U. we find at the size of 1 in. and above 78 p.ct., at 450 B.Th.U. 67·7 p.ct., and at 400 B.Th.U. 61·9 p.ct., and for the smalls below ¾ in., 17·4 p.ct., 22·1 p.ct., and 25·1 p.ct. This is a somewhat serious matter and one which is worthy of further investigation.

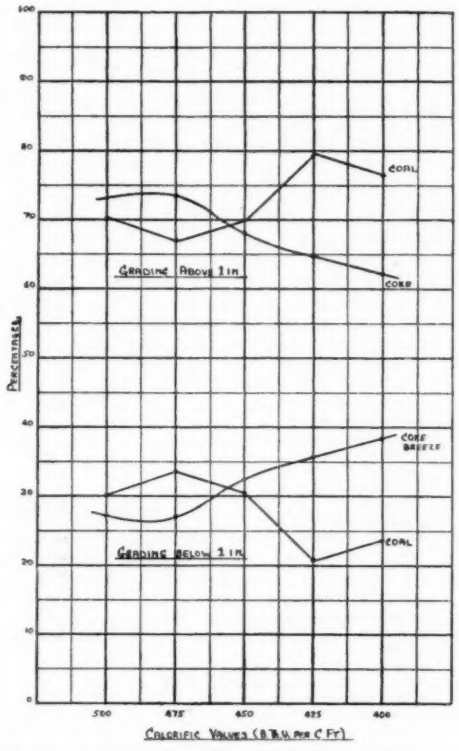


Chart 4.—Showing Coal and Coke Sizings for Various Qualities of Gas Made—see Statement 12.

Looking at the analysis of the screened coke, it is observed that the moisture increase, as the quality falls, is confirmed, while the percentage of volatile again remains constant. Coming to the breeze, the figures are very informative showing excessive quantities of moisture in the lower range of calorific value, 18·81 p.ct. at 400 B.Th.U., whereas in the screened coke from this test the figure was 7·72 p.ct. and unscreened 14·95 p.ct. The volatile matter is consistently higher than that shown in the analysis of

STATEMENT No. 12.—*Showing Efficiency of Coke Screens.*

The efficiency is taken as $\frac{\text{Under size screened out}}{\text{Under size in feed}}$.

Test No.	Type of Screen.	Size of Mesh.	Area of Screen.	Angle of Screen.	Revolutions or Vibrations per Minute.	Horse Power Required.	Material Handled and Grades Produced.	Grading Results from Screens.			Quantity Dealt with in Tons per Hour.	Tons per Sq. Ft. of Screen per Hour.	Efficiency of Screen.
								Breeze.	Nuts.	Coke.			
		In.	Sq. Ft.	Deg.				P.Ct.	P.Ct.	P.Ct.			P.Ct.
1	A	1¾	26·8	13·5	376	3·38	Unscreened coke for removal of breeze	21	..	79	55	2·2	80
		⅝	25·0										
2	B	,,	18·1	29	900	2·64	Do.	20	..	80	28·6	1·57	79
3	,,	,,	,,	,,	,,	,,	Smalls below 1¼ in. for removal of nuts	47	53	..	17·3	0·95	72·5
4	C	,,	23·0	32	700	0·95	Unscreened coke for removal of breeze	14·5	..	85·5	21·8	0·95	71·5
5	,,	1¾	,,	,,	,,	,,	Unscreened coke for removal of screened coke	40·5	..	59·5	25·2	1·1	48
6	D	⅞	20·0	8·5	10 R	2·5	Unscreened coke for removal of breeze	22	..	78	..	..	48
		1¾	22·8	..	..	..	Screened coke for removal of nuts	..	27	73	43·0	1·0	62
7	E	⅞	14·4	40	..	..	Screened nuts from hoppers from removal of breeze	14	86	..	..	..	47
	,,	,,	,,	,,	..	..	Screened coke from hoppers from removal of breeze	5	..	95	..	..	42

the unscreened and screened coke, and this may be explained by less complete carbonization of the small coal. The carbon content again falls fairly consistently with the quality of gas, but the ash content remains more constant. One figure appears to be confirmed by these results—*i.e.*, the coke produced compares favourably, after deduction of coke for producers, with the returns for the various grades as shown on Statement No. 1. The amount of dry coke used for carbonization shows consistency, 11·88 lbs. being consumed at 500 B.Th.U., and 12·81 lbs. at 450 B.Th.U., and 16·04 lbs. per 100 lbs. of coal carbonized at 400 B.Th.U. It should be pointed out that the setting of retorts used for the tests is very thoroughly insulated in order to avoid heat losses. No allowance has been made for carbon in the ashes withdrawn from the producer, but an effort was made in the cleaning and pricking of the fires to see that the loss in this direction was minimized.

TAR AND AMMONIACAL LIQUOR.

The tar produced per ton of coal carbonized is 18·76 gallons at 500 B.Th.U., rising to 27·3 gallons at 450 B.Th.U., and 31·4 gallons at 400 B.Th.U. In this respect it might be pointed out that in one of the coals used there is a small proportion of cannel, and this will account to some extent for such high yields at each quality. While the greatest care was exercised in measuring, I am afraid the figures are on the high side due to the difficulty of separating the liquor; and, indeed, the samples taken for analysis after settling showed a definite separation of water. This was carefully removed and measured, and the amounts are given with the analysis, Statement No. 13. This, I might say, is the only result on which we have doubt as to accuracy, but if tar and liquor are taken together the figures should be reliable.

It will be noted that as the calorific value falls—

(1) The specific gravity of the distillate decreases.
(2) The specific gravity of the residue at 240° C. decreases.
(3) The free carbon content drops.
(4) The concentration of tar acids in the oils, 200°-270° C., increases.
(5) Addition of Durham coal has a slight effect in bringing up the gravity of the tar and of the distillates and in decreasing the tar acid concentration in the 200°-270° C. distillate.

The ammoniacal liquor produced per ton of coal increased rapidly as the quality fell, 49·9 gallons being obtained at 500 B.Th.U., while 54·6 and 77·6 gallons are returned for the grades of 450 and 400 B.Th.U. This would seem to indicate that an excess of steam was being used, and may account for the higher amount of coke used for carbonizing. This is supported by the temperature of the gas leaving the retorts, and at the inlet of the condenser, when producing 500 B.Th.U., the figure was 156° F., and at 400 B.Th.U., 202° F.—a very material factor when condenser capacity is a consideration. The high volume of steam was, however, necessary to produce the gas quality, and its distribution in the retort would appear to be a very important factor when one considers that at 400 B.Th.U. 13·7 tons of steam were used per 24 hours. The ammonia content in the liquor consistently dropped as the qualities of gas were reduced, the figures being 1·294 p.ct., 1·004 p.ct., and 0·822 p.ct., at 500, 450, and 400 B.Th.U. respectively, while the fixed ammonia remained fairly constant throughout. The large volume of weak ammoniacal liquor produced at the lower qualities must considerably add to the cost of producing ammonium sulphate.

ANALYSIS OF COAL.

The importance of a representative sample being available was fully realized if accurate comparisons were to be obtained. A small quantity was therefore collected at short intervals throughout the whole period of coaling. The quantities collected daily were analyzed, and the average results obtained over the three or four days have been

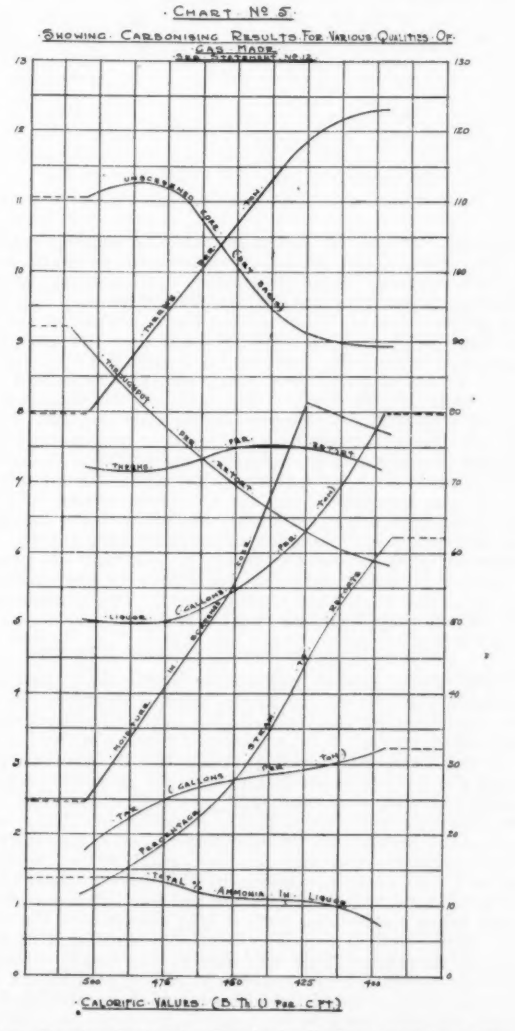


Chart 5.—Showing Carbonizing Results for Various Quantities of Gas Made—see Statement 12.

STATEMENT No. 13.—*Showing Analysis of Tar Produced at the Various Qualities of Gas shown in Statement No.* 11.

[In Test 6 20 p.ct. of Durham Coal was used, and in Test 7 10 p.ct]

Test No.	1	2	3	4	5	6	7
C.V. gas made	500	475	450	425	400	500	500
Product tested	As Collected.	As Collected.	Flask Settled.	Hot Settled in Tin.	Cold Settled in Tin.	Settled in Tin.	Settled in Tin.
Crude tar as tested—							
Water, p.ct. by weight	9·3	13·3	1·3	2·9	6·1	3·5	2·6
Distillation to 240° C. (dry tar)—							
To 200° C., p.ct. by weight	5·95	6·2	3·75	4·3	4·3	4·2	3·4
200–230° C., ,, ,,	7·05	6·1	7·3	8·8	7·6	7·4	6·1
230–240° C., ,, ,,	3·0	3·1	3·55	3·1	2·4	3·3	3·8
Residue and loss, ,, ,,	84·0	84·6	85·4	83·8	85·7	85·1	86·7
Specific gravity of distillates—							
To 200° C.	0·884	0·881	0·869	0·868	0·861	0·867	0·874
200–230° C.	0·958	0·960	0·938	0·936	0·945	0·944	0·946
230–240° C.	0·978	0·971	0·962	0·960	0·962	0·968	0·965
Examination of residue at 240° C. distillation (p.ct. by weight on residue)—							
To 270° C.	6·7	6·9	8·1	8·8	9·0	8·9	10·2
270–300° C.	6·6	7·0	7·8	8·0	9·3	7·6	6·5
300–350° C.	21·7	21·0	21·0	21·6	23·7	17·8	17·6
Pitch and loss	65·0	65·1	63·1	61·6	58·0	65·7	65·7
(P.Ct. by weight on dry tar)—							
To 270° C.	5·6	5·8	6·9	7·4	7·7	7·6	8·9
270–300° C.	5·5	5·9	6·6	6·7	8·0	6·5	5·6
300–350° C.	18·2	17·8	18·0	18·1	20·3	15·1	15·2
Pitch and loss	54·7	55·1	53·9	51·6	49·7	55·9	57·0
	84·0	84·6	85·4	83·8	85·7	85·1	86·7
Specific gravity of distillates—							
To 270° C.	0·989	0·985	0·973	0·969	0·971	0·982	0·974
270–300° C.	0·999	0·996	0·988	0·984	0·986	0·993	0·996
300–350° C.	1·017	1·016	1·008	1·008	1·006	1·018	1·019
K.S. point of pitch at 350° C.	46·7° C.	46·8° C.	47·2° C.	46·7° C.	58·7° C.	47·1° C.	49·7° C.
Other properties of residue at 240° C.—							
Specific gravity at 60° Fahr.	1·109	1·108	1·097	1·094	1·072	1·110	1·110
Viscosity at 86° Fahr., secs.	35·1	24·5	13·6	14·2	17·0	14·0	10·8
Free carbon, p.ct by weight—							
Gross	4·80	4·95	2·92	2·73	2·73	4·56	3·72
Ash	0·03	0·04	0·01	0·00	0·12	0·04	0·00
Net	4·77	4·91	2·91	2·73	2·61	4·52	3·72
Net free carbon calc. to dry tar	4·00	4·15	2·48	2·28	2·24	3·85	3·22
Oils 200 to 270° C.—							
Tar acid concentration, p.ct. v.v.	30·3	31·6	29·8	32·1	35·3	27·2	27·9

returned. It will be observed that the quality remained fairly constant, but the sizing varies somewhat and is difficult to explain, as no alteration was made in the coal-handling plant while the test was in operation. The coking index being low accounts for the large amount of smalls in the coke produced. It will be noted that the quantity of coal sized from 1 in. downwards at 500 B.Th.U. was 50·4 p.ct., at 450 B.Th.U. 48·4 p.ct., and at 400 B.Th.U. 40·6 p.ct. The lowest figure, 36·4 p.ct., is for the test producing 425 B.Th.U. This is shown on chart No. 4. The greater amount of smalls in the mixture used for the higher quality of gas would be helpful in maintaining the calorific value but would be unfavourable when throughput per retort was concerned, and for the lower ranges the effect would be *vice versa*. I doubt, however, if the amount of smalls present is of so much importance once the gas being produced falls below 450 B.Th.U., and for all practical purposes in these tests the variations in the amount of smalls in the coals have been ignored. The various results are shown graphically on chart No. 5.

COST OF GAS ON BASIS OF THESE RESULTS.

With these various particulars one is in a position to compare the cost of gas at the various qualities, and also see the effect of the residual product available, and with this object in view I have prepared Statement No. 14.

It has been mentioned that on the basis of output of plant the quality of 450 B.Th.U. shows up very favourably, producing 4·05 p.ct. and 4·25 p.ct. more therms than at 500 B.Th.U. and 400 B.Th.U. respectively. This has an important bearing on the question of costs, as capital and labour charges rise and fall in similar ratio. There appears to be little to choose in this respect between the highest and the lowest calorific values, but from observations taken during the tests it was shown that the retorts and pipes required greater attention when 400-B.Th.U. gas was being made This was due to the small throughput and consequent slower movement of the coal in the retort causing holding-up of the charge, which necessitated additional rodding, and in the case of the pipes to the higher temperature at which the gas left the retort. For the present purpose, however, it is proposed to ignore these charges confining our comparison to costs of materials and residual products; but, if anyone wishes to add the labour charges, I have shown details of these for 500-B.Th.U. gas in Statement No. 5. The ammoniacal liquor as sulphate equivalent has not been taken into account owing to the present market value.

The total expenditure for 500-B.Th.U. gas is £141·28 or 2·95d. per therm, whereas when producing 400 B.Th.U. we have £104·02 equivalent to 2·17d., representing 36 p.ct. more working capital for the former calorific value. It is true that this is compensated for to a very large extent by the revenue available from residuals, but stocks of both coal and coke are involved. Looking, however, at the details one must be impressed with the part which the price of coal plays in cost of production, and on this account I plead that good selection justifies a reasonable outlay in expenditure to see that the most suitable qualities and grades available are being purchased. I have always doubted the wisdom of purchasing small sized coal such as singles, doubles, and trebles for vertical retorts working, and still do so, as I have not yet found the results at any quality of gas as efficient as those obtained from a mixture of broken coal with a fair percentage of fines. This may be due to the initial high quality of the coal gas produced permitting a larger amount of water gas being produced by steaming. The fuel used in the producer is worthy of our most serious attention, as it will be observed that to produce 11,483 therms at 500 B.Th.U. 16·83 tons were required, costing 0·32d. per therm, whereas at 450 B.Th.U. and 400 B.Th.U. the figures are 11,948 therms, 13·13 tons, and 0·24d.; and 11,464 therms, 14·99 tons, and 0·28d. respectively. From a fuel conservation point of view it would appear that the middle range of qualities is the most efficient and the highest calorific value the least. There is, of course, the heat carried into the retort by the steam, and while this is used in the water gas reaction and probably does not affect the position, so far as carbonization is concerned, it is interesting to record it.

At 500 B.Th.U. 39,100 lbs. of steam were used, representing 45·8 million heat units, equivalent to 3670 lbs. of coke, and at the lowest quality 123,000 lbs., or 146 million heat units, and 11,720 lbs. of coke. These fuel figures, how-

STATEMENT No. 14.—*Showing the Cost of Producing the Various Qualities of Gas shown in Statement No. 11.*

Coal, 17s. 5d. Coke, 18s. Breeze, 7s. 6d. Tar, 2d. per gallon. Sulphate, *nil.* Steam, 1s. 6d. per 1000 lbs.

C.V., B.Th.U. per C.Ft.	500				475				450				425				400			
	Quantity.	Costs. £	Costs. Per Therm. Pence.	Costs. Per 1000 C.Ft. Pence.	Quantity.	Costs. £	Costs. Per Therm. Pence.	Costs. Per 1000 C.Ft. Pence.	Quantity.	Costs. £	Costs. Per Therm. Pence.	Costs. Per 1000 C.Ft. Pence.	Quantity	Costs. £	Costs. Per Therm. Pence.	Costs. Per 1000 C.Ft. Pence.	Quantity.	Costs. £	Costs. Per Therm. Pence.	Costs. Per 1000 C.Ft. Pence.
Expenditure—																				
Coal carbonized, tons	141·64	123·2	2·57	12·9	91·29	79·5	2·22	10·57	111·14	96·8	1·95	8·75	100·32	87·5	1·77	7·52	93·46	81·3	1·7	6·82
Coke to producers, tons	16·83	15·15	0·32	1·59	11·48	10·33	0·29	1·37	13·13	11·82	0·24	1·07	13·19	11·87	0·24	1·02	14·99	13·5	0·28	1·13
Steam to retorts in 1000 lbs.	39·1	2·93	0·06	0·31	37·7	2·83	0·08	0·38	68·0	5·1	0·10	0·46	98·5	7·38	0·15	0·63	123·0	9·22	0·19	0·77
Total expenditure		141·28	2·95	14·80		92·66	2·59	12·32		113·72	2·29	10·28		106·75	2·16	9·17		104·02	2·17	8·72
Revenue—																				
Coke available (dry), tons	42·58	38·30	0·80	4·01	24·68	22·2	0·62	2·95	26·68	24·0	0·48	2·17	16·87	15·18	0·31	1·3	12·41	11·18	0·23	0·94
Breeze available, tons	19·14	7·18	0·15	0·75	14·68	5·51	0·15	0·73	15·87	5·95	0·12	0·54	15·84	5·83	0·12	0·50	14·27	5·35	0·11	0·45
Tar available, galls.	2,667	22·21	0·46	2·32	2267	18·9	0·53	2·51	3,005	25·0	0·50	2·26	2,903	24·2	0·49	2·08	2,974	24·75	0·52	2·08
Liquor as sulphate, tons.	1·22	..	..	..	1·02	..	..	..	0·86	..	..	..	0·88	..	..	..	0·85	..	..	..
		67·69	1·41	7·08		46·61	1·30	6·19		54·95	1·10	4·97		45·21	0·92	3·88		41·28	0·86	3·47
Net cost of production on basis of—																				
Dry coke		73·59	1·54	7·72		46·05	1·29	6·13		58·77	1·19	5·31		61·54	1·24	5·29		62·74	1·31	5·25
Dry ash-free coke		76·40	1·60	8·01		47·66	1·33	6·34		60·93	1·23	5·52		62·81	1·28	5·39		63·18	1·32	5·3
Coke as produced		71·89	1·51	7·53		44·51	1·25	5·92		57·27	1·15	5·18		60·29	1·22	5·19		61·68	1·29	5·17
Gas made, 1000 c ft.	2,292				1807				2,654				2,791				2,860			
Gas made, therms	11,483				8592				11,948				11,883				11,464			

ever, clearly show the tremendous advantage derived from the utilization of the heat in the coke from vertical retorts for the production of water gas, but from the figures available one is inclined to conclude that at about 450 B.Th.U. quality a point arises in the throughput per retort where

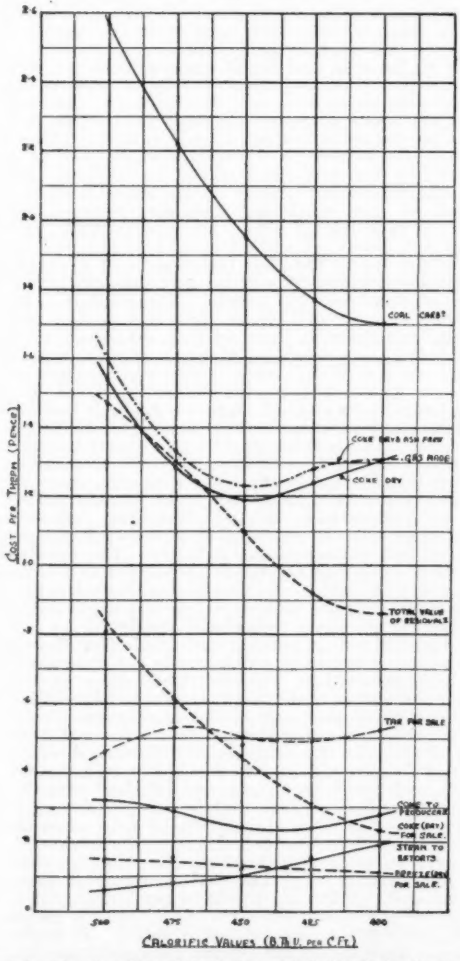


Chart 6.—Showing Cost of Coal, &c., and Residuals for Various Qualities of Gas Made—see Statement 14.

there is just sufficient residual heat in the coke itself to crack the steam for the amount of water gas necessary to dilute the coal gas to the desired calorific value, and for qualities below that figure additional coke has to be used in the producer to maintain the temperature for the steam reaction, which has a definite bearing on the cost of production.

Looking at the total revenue available, it will be seen we have at 500 B.Th.U. 1·41d. per therm, representing 54·9 p.ct. of the cost of coal; at 450 B.Th.U. 1·10d. and 56·8 p.ct.; while at 400 B.Th.U. we find 0·86d., equivalent to 50·8 p.ct. The details of the revenue show how easily and how much the price of gas can be affected by the market values of residual products. The solid residue coke and breeze available at 500 B.Th.U. provides 67·1 p.ct. of the total revenue from residuals and tar 32·9 p.ct. At 450 B.Th.U., this distribution alters to 54·5 p.ct. and 45·5 p.ct., while at 400 B.Th.U. we find 40 p.ct. for the solid and 60 p.ct. for the liquid products, the position being reversed.

From this we can conclude that a change in the price of coke and breeze will affect the cost of gas produced at the higher ranges more than at the lower calorific values, and in the case of tar, *vice versa;* but the balance at 450 B.Th.U. is again very prominent, the revenues from both sources showing little variation, while an alteration in the price of one residual will not have such a serious effect on the cost of gas produced.

The net cost on the basis of dry coke brings out some very interesting figures, the lowest being 1·19d. at 450 B.Th.U., followed by 1·24d. at 425 B.Th.U., 1·29d. at 475 B.Th.U., 1·31d. at 400 B.Th.U., and 1·54d. for the highest value.

The figures on basis of coke as produced and on dry ash-free basis are also given, but do not alter the comparison. These costs are shown graphically on chart No. 6. With the prices ruling when this statement was prepared one may conclude that with average Scotch coal the most economical quality of gas from a production point of view is in the region of 450 B.Th.U., and this is strongly supported by the number of undertakings supplying it. A change in the price of coal, a drop in the value of coke or tar, would immediately alter the position; but from whatever angle I have approached the subject I have been impressed with the consistency of the results and costs following the middle range of quality—so much so that I consider it would make an efficient and ideal standard declaration for Scotland whether gas is produced in verticals or by the two-stage process.

The question of quality of gas has probably been the most discussed subject in our Industry in recent times, and it is somewhat hackneyed now. The position, however, which 500-B.Th.U. gas occupied in relation to other qualities had not, in my opinion, been disposed of, and it was for this reason that I ventured to open up the question anew. I approached it with an open mind, determined if possible to get reliable data from which comparisons could

be made, and from the results obtained think I have accomplished it with a fair measure of success. I have endeavoured to put up a case to justify the production of 500-B.Th.U. gas from average Scotch coals in continuous vertical retorts.

At the outset I felt convinced that my case could be proved, and that would have been so had the market values for residuals remained as they were when I commenced to prepare my notes. In the interval, however, a serious slump, and, in my opinion, a permanent one, has taken place in the price of coke from which the greater proportion of revenue is derived when producing high-quality gas, while the price of tar has increased, placing the lower qualities in a more favourable position.

I have no doubt many of the conclusions I have arrived at and statements I have made will be disputed, that discrepancies, and what might appear inconsistencies, may be pointed out, but the one thing I do hope will be accepted without reserve is the earnestness of my endeavour to get an accurate comparison.

I wish to acknowledge my indebtedness to my Chief, Mr. Gracie, for the permission he has kindly given me to carry out the tests and publish the results, and to the various assistants who carried out the work, necessitating as it did shift work and week-ends on duty.

Discussion.

Mr. A. S. Nisbet (Paisley) said he appreciated the difficulty of reconciling the high yield of tar with the high thermal yield of high quality gas. There was no question about the difficulty in maintaining the 500 B.Th.U. standard in towns where the testing station was far distant from the works, and where the testing had to be carried out twice it imposed a strain on the management.

Mr. George Braidwood (Coatbridge) said that before attempting to criticize Mr. Jamieson's paper he would like to say that it was one dealing with his pet subject and one on which he might be submitting a paper later. It was not usual in making comparisons to name the different undertakings, and if Mr. Jamieson had meant to set the heather on fire he could not have adopted a better method. The author had throughout his paper dealt with the therm, and rightly so. It was to be deplored that so many undertakings selling gas by the therm still published their returns in cubic feet. Even the Board of Trade still made their Gas Fund Charge on the cubic foot basis, and incidentally to the advantage of the high quality undertakings. In going over the list of works whose cost of gas into holder was mentioned by Mr. Jamieson, one was led to believe that the Coatbridge Undertaking sat on the top of a pit shaft—the tar distiller pined for its tar, while the people in Coatbridge ate coke, and drank the liquor. In the same paragraph mention was made of a poor unfortunate who bought coal cheaper than anyone else, produced 10 more therms per ton, but whose net cost of coal was double that of Coatbridge owing to the fact that none coveted his tar, nor would his people eat coke.

However, he suspected Mr. Jamieson of leg-pulling; he was too astute a gentleman not to have smelt a rat when he noted that the undertakings with the lowest cost into the holder were all making such very low thermal yields *per ton*. Coatbridge was suspect because of its high tar yield, and this, Mr. Jamieson thought, might be due to low heats, but how could he reconcile this with the fact that in his test figures the tar return jumped as the temperatures rose and the gas quality fell? The consistently low gas yields given by the other 475 B.Th.U. undertakings were not due to low heats, but rather the reverse. The management of these undertakings did not chase that financial "will o' the wisp" supposed to be caught by "make per ton," neither did they calculate results on a per ton basis. It occurred to him that a most useful exercise would be to imagine what would happen financially if one manufactured one's total thermal requirements of gas on similar lines (using "Gas World" Analysis figures) to those used by the other fellow. Of course, it would help if one knew the other fellow's carbonizing theories. This remark was not intended as a joke, because on, say, a 16-million therm make (calculated on "Gas World" Analysis figures) differences in the net cost of coal of from £20,000 to £40,000 could easily be obtained by different methods of carbonizing, using similar material in the same type of plant. Mr. Jamieson finally concluded that a gas of 450 B.Th.U. quality was perhaps, after all was said and done, the most economical quality to make, and he thought this must be so because of the number of undertakings supplying it. It was difficult to support this view, as reference to the "Gas World" Year Book for 1932 showed that in Scotland—

24,244,000 therms were supplied under 450 B.Th.U.
17,320,000 ,, ,, ,, at 450 B.Th.U.
82,590,000 ,, ,, ,, over 450 B.Th.U., or
19·6 p.ct. at under 450,
13·9 p.ct. at 450, and
66·5 p.ct. at over 450,

the average being 465.

He was of opinion that Mr. Jamieson's final conclusions had been completely upset by the high tar yields obtained in his tests. Had the tar figures shown in the "Gas World" Analysis been taken, the final costs per therm would have shown that a 475-500 B.Th.U. gas was the most economical quality to make, always provided one could dispose of the residuals. He trusted that Mr. Jamieson had not allowed the fact of further water gas plant being installed in Edinburgh to influence his ideas on quality.

In view of this he considered Mr. Jamieson's attempt to suggest a standard quality of 450 for Scotland rather premature. Personally he thought a standard quality unnecessary unless and until a grid system of distribution was adopted. After all, each of them supplied gas inside their own area of a standard quality. By the adoption of a national standard the working of many valuable types of carbonizing plant would be cramped, and at the same time defeat the object of the Gas Regulation Act in its freedom of operation. Mr. Jamieson's paper called for very careful study as he was sure they would agree that it was a most valuable contribution. Personally he had learned much from it, as he considered this subject to be one of the most live before the Industry at the present time.

Extremes Not Expedient.

Mr. J. W. McLusky (Glasgow) said that ten years ago, when this subject was fully discussed by the North British Association, there were strong advocates for various standards of quality between 400 and 500 calorific value. It was interesting to recall that, in 1922, 100 B.Th.U. separated the highest from the lowest enthusiast, and now, ten years later, they found that only 1 p.ct. of the therms sold by the entire Gas Industry was of a quality of 400 B.Th.U. or lower. Approximately 46 p.ct. of the gas sold was of a quality between 410 and 480, and 43 p.ct. was over 480 calorific value. These figures proved conclusively that the officials responsible for policy had determined that extremes in standards were expedient neither for the carbonizing engineer nor for the salesman who was endeavouring to serve the best interests of the consumer. Mr. Jamieson admitted that in producing the 500 standard in vertical retorts there was occasional strain and anxiety to harness a few units extra as and when necessary. He was, so to speak, at the end of his calorific tether. On the other hand, the advocate of the values between 420 and 400 must admit that this quality was much more sensitive in appliances and fittings than, say, the Glasgow quality of 470.

Of course, there were local conditions to consider. Determining factors such as proximity or otherwise to coalfields, types of plant, and ability to dispose easily of residual products were influences which called for examination in attempting to dogmatize on a national standard. Mr. Jamieson confessed that it was easier to prove his case for 500 calorific value at the outset of his paper than at the conclusion, because during the period in which he prepared his contribution the country had experienced a serious slump in the coke market. Now Mr. Jamieson knew, as did every member of the Association, that they could not change their calorific value policy with the vagaries of the coke and liquid products market. Therein lay another reason why the declared calorific value should be a moderate one, keeping in view the varying commercial experiences of the past ten years. It seemed to him that the author's remarks on the coke position were justifiable. There was one consolation for Edinburgh—they could export half of their output, and they had excellent facilities for shipping. In Glasgow some people told them that they should sell all their coke locally. That was an ideal which they had been pursuing, but during the pursuit they had to export the surplus coke. It would be interesting to producers and sellers of coke to know that during the past five years the Gas Department of Glasgow shipped against foreign orders 37 p.ct. of its total output of coke—an average of 86,492 tons per annum. The steadying effect which this policy brought to bear on the home market need not be laboured. At the same time he wished to draw the attention of members to yet another statement. In the neighbourhood of Glasgow—that was to say, within easy railway carriage—there were 42 gas undertakings which produced for sale per annum 120,000 tons of coke. Apart from their local sales these 42 undertakings sold outside their areas three times the tonnage of Glasgow, and that despite the fact that Glasgow exported 72 p.ct. of the total production of their 42 neighbours. It was quite legitimate competition to send coke where a customer demanded a certain quality and paid a good price, but the policy of undercutting without increasing sales—frequently without rhyme or reason—displayed a woeful lack of interest in the general welfare of the Industry. The members of the Association could imagine the coke position in Scotland if the six largest undertakings for any reason ceased exporting. Of course, so long as the present policy was continued, the home market ought to remain normal and steady.

Mr. John Wilson (Dundee) remarked that there were one or two points in regard to which he was not altogether in agreement with the author. Under the heading of "Coke and Breeze," the author made this statement: "It will be observed that I have given the analysis of the unscreened coke, and, in addition, the figures for the screened coke and breeze. The former shows that the moisture content varied very considerably, and is returned at 2·25 p.ct., 5·10 p.ct., 14·95 p.ct. for 500, 450, and 400 B.Th.U. gas respectively." On that matter he (Mr. Wilson) would say that it was not necessary to have fully 14 p.ct. of moisture in unscreened coke when making 400 B.Th.U. gas. Scientific experience went to show that such coke could be made with less than 5 p.ct. of moisture. Then, under the heading of "Tar and Ammoniacal Liquor," Mr. Jamieson said: "The tar produced per ton of coal carbonized is 18·76 gallons at 500 B.Th.U., rising to 27·3 gallons at 450 B.Th.U., and 31·4 gallons at 400 B.Th.U." It might be true that these were the actual results obtained from the author's experiments, but it had not happened to most practical people

to get over 30 gallons of tar with ordinary working. As a matter of fact, he did not believe these figures at all, and he feared something had gone wrong. The author assured them that he was unbiassed; but he (Mr. Wilson) had the notion that he started out to advocate gas of 500 C.V. quality. Apparently he had come to a somewhat different decision now, because he appeared to have a leaning towards something round about 450 B.Th.U. At one point he seemed favourable to a 475 standard, but latterly he dropped to 450. There had been a lot of talk about economics in the production of the therm, and Mr. Jamieson had been proving in his own way the cost of the therm as it applied to various qualities of gas. Something, however, was being lost sight of, which had relation to economics in the use of the therm. What did it matter if they produced a good and cheap therm if the consumer lost efficiency in the use of that therm? Having regard to production, he (Mr. Wilson) thought that 450 calorific value was round about the most economical standard of gas that the consumer could use, and having that in mind he was disposed to agree with the author that it would be a step in the right direction if they could as an Industry find agreement upon some standardized quality.

Question of Local Circumstances.

Mr. D. Fulton (Helensburgh) thought the great value of Mr. Jamieson's paper was that it might give them direction along lines that were suitable to their works. The Edinburgh data could be compared with the figures they themselves obtained. The primary proposition Mr. Jamieson set out to ascertain was what was the most economic calorific value of gas for Scotland. The whole subject, however, was bound up with the geographical situation of undertakings, with the nature of the plant, the character of the distributing system, and a number of other variable factors. He believed, however, that there was a possible range for standardization between 420 and 475 B.Th.U. Perhaps they might even go so far as to say that 500 B.Th.U. was, in the mind of the author, the limit of the range. Mr. Jamieson's observations with regard to the most suitable fuel for use in vertical retorts were interesting, because if he (Mr. Fulton) asked twelve gas engineers to state the fuel they found most adaptable for verticals they would reply "sized nuts." Yet the author had proved to his own satisfaction at any rate that it was much more profitable and much more efficient to use large coal which contained a large amount of fines.

Mr. J. Richmond (Penicuik) said it would be presumption on his part to criticize the voluminous treatise they had been favoured with from Mr. Jamieson, but the feeling he had was that this was purely and simply a manufacturer's paper. He (the speaker) thought it would be valuable if the same subject could be approached from the points of view of the consumer. Mr. Wilson had mentioned what he thought was the cheapest standard of gas to manufacture from the viewpoint of the producer, but would it not add to their knowledge if they could be told what was the best calorific value to adopt in the interests of the consumer? It would be valuable if Mr. Jamieson, with his great facilities for research in Edinburgh, would continue his investigations and give them, later on, details of the most efficient gas to be used in the interests of the consumers, as well as the most economical from the standpoint of the manufacturers.

Efficient Utilization.

Mr. James Bell (Dumbarton) heartily agreed with the remarks made by Mr. Wilson. This was not so much a question of producing high-grade gas or low-grade gas as of ensuring that the consumers got the best value in utilization. He quite agreed with the remark that had been made that gas of 450 calorific value would be the ideal quality to adopt as a standard, and it did seem to him that they could not expect to get efficient appliances until they had taken the first step of adopting a national standard quality of manufacture throughout Scotland

Mr. J. K. Frazer (Dalmarnock) said that his experience at Dalmarnock in sending out large quantities of coke was that 10, 12, or even 20 wagons might be excellent material, but one wagon—say, the 11th or the 21st—would contain all the breeze that should have been spread over the whole of the bulk.

Mr. David Vass (Perth) thought the paper contained a mass of useful information; and it so happened that at the present juncture it was going to be particularly valuable and serviceable to him. In Perth they were making 450 quality gas on the basis of 15,000 c.ft. to the ton. It occurred to him, however, that if they could make 18,000 c.ft. to the ton they might gain in the long run, even although they lost somewhat in the coke market. Recently in Perth they found that they could produce 18,000 to 18,500 c.ft. of 450 quality gas without any great effort, but unfortunately the amount of coke required to make that quantity of gas was by no means small.

The Author's Reply.

Mr. Jamieson, in reply, said the discussion had not developed along the lines he had anticipated. He fully expected that all his arguments would have been torn to shreds. He thought that Mr. Braidwood was most favourably situated in respect of his residual products market. Regarding the number of undertakings supplying 450 B.Th.U., Mr. Braidwood acknowledged having extracted his list from the "Gas World" Year Book, but it ought to be borne in mind that there were many small undertakings not included in that particular list. For the purposes of the present paper he took out the figures relative to the municipal undertakings as given in the "Gas World Analyses of Accounts," and he believed that the majority of these were making 450 B.Th.U. gas. His own opinion, however, was that there were more companies making 500 B.Th.U. than 450; and he thought that particularly applied to the smaller companies in the country districts. In including the Coatbridge Undertaking in the list presented in the paper, he rather thought he was paying Mr. Braidwood a compliment. So far as the remarks made by Messrs. McLusky, Wilson, and some of the other members of the Association were concerned, he thought it would be a step in the right direction if the Gas Industry would come to agreement on a fixed standard. He had the feeling that the time was past when 500 B.Th.U. could be produced efficiently, and they ought to agree on 475, 450, or 425 B.Th.U.

Register of Patents

Extracting Coke from Vertical Retorts. No. 374,968.

Woodall-Duckham (1920), Ltd., and Duckham, A. M., both of Victoria Street, S.W. 1.

No. 5621; Feb. 23, 1931.

This invention relates to means for extracting coke from continuously operated vertical retorts. In installations of this kind it is common practice to deliver coke from the bottom of a retort on to a vertically movable platform arranged within a suitable casing, the coke being periodically removed from the platform by opening a door in the bottom of the casing or by tilting the latter and discharging the coke laterally.

During an operation of this nature it is necessary to support the remainder of the charge in the retort in order to prevent a free rush of coal and coke through the retort. For this purpose, according to the invention, the retort proper has at its lower end an extension of greater cross-sectional area than the remainder of the retort, this extension being conveniently of bulbous formation. The discharged coke is caused to pass into this extension, where it is held in place by supporting prongs which may be in the form of a rotary plate which can be brought into an operative or supporting position by means of a shaft. Owing to the considerable volumetric capacity of the extension a certain loosening of the deposited coke takes place, so that instead of crushing the coke by penetration the supporting prongs slightly lift it.

The chamber or casing beneath the extension is provided with a swinging door that gives access to a lateral offtake, which is provided at its outer end with an outlet door for discharge of the coke, these doors being interconnected in such manner that they open or close simultaneously.

A vertically moving platform as previously mentioned is adapted to be displaced within the casing or chamber for the coke and to receive the latter as it is discharged from the extension, and this platform is displaced by a lazy tongs device. The rate of descent of the platform would not normally be regular, but dependent upon the relative angular positions of the members forming the lazy tongs. To overcome this objectionable feature the means for operating the lazy tongs is provided with means for automatically ensuring a uniform speed of descent of the platform.

Adjustable shoes to take up wear are inserted between the inner surface of the extension and the outer surface of the rotary plate. The side walls of the coke chamber are provided with a renewable wearing strip. The extension is preferably integral with the coke receiving casing or chamber.

Prepayment Mechanism.—No. 374,877.

Parkinson & Cowan (Gas Meters), Ltd., and Williams, T., both of Kennington Road, S.E. 11.

No. 7933; March 14, 1931.

This invention relates to prepayment mechanism for gas meters of the type in which the gas valve to be controlled is operated from a scroll or spiral cam which enables a considerable movement to be imparted to such mechanism between the open and closed positions of the valve—that is to say, which enables prepayment to be made for a considerable quantity of gas.

The object is to provide improved mechanism which can, if desired, be adapted for operation by coins of different sizes without it being necessary to make any changes by hand in the arrangement of the prepayment mechanism. The invention comprises the arrangement wherein the scroll or spiral cam operates a lever so as to move the latter across the face of the cam until the end of the cam groove engages the lever, when the latter is carried circumferentially by the cam for the purpose of closing the gas valve.

The invention further comprises the actuation of the scroll cam through a differential gear, in part rotated by the prepayment mechanism and in part by the metering mechanism.

The invention further comprises the actuation of the scroll cam through two differential gears, one gear being actuated by one or other of two mechanisms depending upon the size of the coin by which prepayment is made, and the other gear being actuated from the former and from the metering mechanism.

A New Technique of Heat Transfer*

By W. L. McCabe, Assistant Professor, Department of Chemical Engineering, University of Michigan.

[*We have received from the University of Michigan a copy of Bulletin No. 23, which gives an account of research into the use of diphenyl vapour for heating asphalt. Though this application may not in itself be of first interest to our readers, the following account of the use of diphenyl vapour as a heating agent is worthy of attention and may prove suggestive in regard to other channels.*—Ed. "G.J."]

In most heating operations, except those involving electrical heat, the heat energy is obtained from the combustion of a fuel, and is transferred to the material or space to be heated either directly or indirectly. In direct heating, the hot products of the combustion of the fuel are brought into contact with the walls of the vessel that contains the material to be heated, or, in some cases, even with the material itself. Direct heating is used in the raising of steam in a boiler, in the manufacture of lime by the calcination of limestone, and in the heating of organic materials such as coal, wood, or petroleum in stills or retorts with direct fire. Electric-resistance heating with immersion units is also a direct-heating method, since the conversion of electrical energy into heat takes place in close proximity to the material being treated. In heating by the indirect method, the heat of combustion is transmitted to an intermediate fluid or heat carrier, and is then transferred from the carrier to the material to be heated. The equipment used in indirect heating includes at least three parts: the heat-absorbing unit by means of which heat is transferred to the carrier from the burning fuel; the heat-releasing unit by which the heat is removed from the heat carrier at the point of use; and a circulation system for transporting the working fluid back and forth between the absorber and liberator. The ordinary steam house-heating system is a good example of indirect heating, as are also the water-cooling system of an automobile, and the Merrill process of heating by circulating hot oil.

Indirect heating methods vary considerably according to the action of the heat on the working fluid. One type of indirect heat is illustrated by the use of steam heat. In this case hot water is sent to the boiler, or heat-absorbing unit, where it is vaporized to form steam by the heat transferred through the walls of the absorber. The change of the water from liquid to gas does not itself result in a change in temperature; the heat required by the change is "latent" heat. The steam formed in the absorber is delivered to the radiator, or heat-releasing unit, where it is condensed to the liquid. The heat liberated is the latent heat added in the boiler. No temperature change need take place, and in the ideal case the entire cycle of operation of the working fluid is isothermal or at constant temperature, and only latent heat is carried from the heat absorber to the heat liberator.

The second type of indirect heating is characterized by the use of a circulating liquid or heat carrier that remains in the liquid state throughout the cycle of operation. In this case, cool liquid enters the heat-absorbing unit, and picks up heat at temperatures well below the boiling temperature of the carrier. The absorption of heat, therefore, increases the temperature of the carrier. The hot carrier is sent to the heat-releasing unit where heat is abstracted from the liquid, and cool liquid is sent back to the absorber. In such a case, only heat represented by change in temperature, the so-called sensible heat, is involved, and a considerable temperature difference between the streams of carrier leaving the absorber and returning to it is essential to the operation of the system.

Present Methods of Heating Asphalt.

All the methods of heating described are used in the heating of asphalt. The temperatures to which asphalt is heated in manufacture or use vary over considerable limits. For paving purposes, the asphalt is applied at the comparatively low temperatures of 225° Fahr. to 350° Fahr. On the other hand, in dehydrating asphalts, in preparing roofing asphalts by "blowing" asphalt fluxes with air, and in many impregnation processes, temperatures of 400° Fahr. to 600° Fahr. are used, although temperatures of over 550° Fahr. are rare, as thermal decomposition begins at about 600° Fahr.

Direct-fired stills and containers have been, and are, commonly used. In such direct methods, however, control is difficult, local overheating often results, causing thermal decomposition of the asphalt with loss in quality and the formation of a coke residue, and thermal efficiencies are usually low. For these reasons, direct heating methods are being gradually abandoned.

Steam, which is used as a latent heat carrier, is ideal where the temperature of heating will allow its use. The temperature that can be reached with steam at moderate pressures is, however, comparatively low. At 350° Fahr., for example, the pressure of saturated steam is 120 lbs. per sq. in. gauge, and steam at a pressure higher than this is necessary if asphalt is to be heated to 350° Fahr. with saturated steam. For a temperature of 500° Fahr., the corresponding steam pressure must be 660 lbs. per sq. in. gauge. Equipment that will stand such a pressure is expensive. Steam at pressures above 150 lbs. per sq. in. gauge is therefore seldom used for heating purposes. The practical temperature limit of such a heating operation is about 350° Fahr., since the steam must be definitely hotter than the asphalt if a reasonably rapid rate of heat transfer is to be attained.

The Merrill system is typical of the indirect methods in successful use in asphalt practice. The heat carrier in this system is a heavy petroleum oil of high thermal stability. Such an oil can be heated to about 550° Fahr. without decomposition. By this method asphalt can be heated to 500° Fahr. The disadvantages of the method are that the temperature is definitely limited by the stability of the oil used, the rate of heat transfer to the oil is low, and the process lacks the isothermal feature obtainable in a latent heat transfer.

Proposed Method of Heating Asphalt.

The method developed in the research reported in this Bulletin is an indirect method of latent heat transfer. It has the advantages of control, isothermal operation, high rate of heat transfer, and high maximum temperature. The heat-carrying medium is diphenyl ($C_6H_5 . C_6H_5$). A closely related material, diphenyl oxide ($C_6H_5 . O . C_6H_5$), also can be used, although the maximum temperature obtainable is not quite so high, since diphenyl oxide is less stable than diphenyl. Mixtures of the two materials can be used, and offer certain advantages over the use of either simple substance. The actual experimental work upon which the method proposed was based was carried out with diphenyl. All results obtained with diphenyl are substantially valid for diphenyl oxide or for mixtures of the two.

Properties of Diphenyl.

Diphenyl is a wax-like solid at room temperature. It has a distinctive geranium-like odour. It melts at 156° Fahr., and boils under normal atmospheric pressure at 492° Fahr. It is non-poisonous. At 100 lbs. per sq. in. gauge, its boiling temperature is 705° Fahr., and at 150 lbs. per sq. in. gauge its boiling temperature is 756° Fahr.

The material is remarkably stable chemically, and is absolutely non-corrosive to ordinary materials of construction. Unlimited quantities are available at a cost of about $0·17 per lb. in carload lots. Liquid diphenyl is pumped and transported in the same manner as any liquid, and as a liquid its viscosity is low. Although certain precautions with respect to joints and pump stuffing boxes are necessary, diphenyl liquid or vapour can be handled in practically the same manner as steam or water. When heated by direct fire diphenyl must be kept in positive circulation, but if this precaution is taken, it can be heated very rapidly without danger of decomposition. It can be used under commercial conditions at 750° Fahr. with substantially no deterioration with use. Its flash-point is high enough so that, with ordinary precautions, the fire risk is negligible.

Special Apparatus.

In the experimental investigation of the effect of heating asphalt with diphenyl vapour, a simple boiler was used. As a result of a parallel investigation a commercial scale diphenyl boiler, or heat-absorption unit, was also developed. An experimental heat-releasing unit or asphalt heater was constructed and operated.

Boiler: The development of the heat absorber or boiler was carried forward in an independent, parallel investigation. Asphalt heating is only one of a number of potential applications of diphenyl heating, and the development of the boiler was essential to all of them. The design adopted

* Department of Engineering Research, University of Michigan, Ann Arbor. Engineering Research Bulletin No. 23. Price $1.00.

and proved effective is of the pipe-still type and uses forced diphenyl circulation. It has been found that in this boiler, high capacities can be attained without decomposition of diphenyl, as long as a reasonable circulation rate is maintained.

Heater: The asphalt heater consisted of a single tube in an annular jacket that was supplied with diphenyl vapour. The asphalt was circulated through the inner tube by a variable-speed, positive-pressure pump. Two heating tubes were used. The first was a standard 1-in. iron pipe. The second was a standard 1¼-in. iron pipe. The heated length of each pipe was 9·3 ft. A double-pipe cooler was installed in the circulating system to cool the heated asphalt to the entrance temperature of the heating tube. The apparatus operated continuously.

Experimental Procedure.

The investigation had as its objective the determination of the answers to three fundamental questions:

1. Can asphalt be heated with condensing diphenyl vapour without mechanical or operating difficulties?
2. Will the asphalt be impaired in quality if heated with diphenyl vapour?
3. What will be the rate of heat transfer from condensing diphenyl to asphalt?

In this work, there was no intention to set up and operate other heating methods to compare directly their behaviour with that of the diphenyl method. The purpose of the experiments was to determine the characteristics of the diphenyl technique and not to eliminate existing methods. Any new method can be developed completely only by full-scale plant experience. The results of the present experiments should, however, pave the way for plant scale work as the next step.

Results of Experimental Work.

Many experimental heat transfer runs were made and the three questions concerning the heat transfer from condensing diphenyl to asphalt were definitely answered.

1. It was found that the actual handling of asphalt and diphenyl was entirely practicable and that asphalt can be heated in this way with splendid control and at a relatively high rate. All mechanical difficulties that appeared during these semi-commercial tests were solved.
2. The heat-transfer rates were found to be quite uniform and varied but little with operating conditions. The bulk of the tests showed that from 280 to 350 B.Th.U. per sq. ft. per hour per ° Fahr. can be transferred from the diphenyl vapour to the wall of the tube carrying the asphalt, and that 35 to 50 B.Th.U. per sq. ft. per hour per ° Fahr. are transferred from the wall to the asphalt. This is equivalent to an overall heat transfer rate from diphenyl to asphalt of 31 to 44 B.Th.U. per sq. ft. per hour per ° Fahr.
3. No increase in the percentage of free carbon in the heated asphalt was detected. The experimental work finished with a continuous 32-hour run, with as high as 220° Fahr. temperature difference between diphenyl and asphalt, with asphalt velocities as low as 1·8 ft. per sec. and with average asphalt temperatures as high as 390° Fahr. At the end of the period the asphalt had lost so much volatile matter that the residual material was too stiff to be moved with the pump at 390° Fahr. No free carbon was formed under these conditions. It was not found possible to coke asphalt in the experimental apparatus. Furthermore, there were no carbon deposits on the heating tube at the end of the run.

Association of Public Lighting Engineers

NINTH ANNUAL CONFERENCE AT BLACKPOOL

The Ninth Annual Meeting and Conference of the Association of Public Lighting Engineers was held at the Imperial Hotel, Blackpool, from Sept. 5-8. An Exhibition of public lamps and lighting equipment was also arranged in the basement of the hotel, where it was formally opened by the MAYOR OF BLACKPOOL (Councillor L. Newsome, J.P.) on Monday evening, Sept. 5, during the Association Reception. There was an attendance of some 280 delegates, members, and visitors—the largest attendance at any conference of the Association. An account of the exhibits of interest to the Gas Industry was published in the "JOURNAL" last week.

The Conference was opened at the Imperial Hotel on Tuesday morning, Sept. 6, when the MAYOR OF BLACKPOOL offered the Association a civic welcome, in the course of which he commented on the importance of the work being done by the Association in the interests of the whole community.

The RETIRING PRESIDENT (Mr. R. Beveridge, Lighting and Cleansing Superintendent, City of Edinburgh), who was in the chair during the early proceedings, expressed the thanks of the members of the Association to the Mayor and Corporation of Blackpool for the invitation to hold the conference in that town, which had attracted a record attendance.

The NEW PRESIDENT (Mr. Harold Davies, Gas Engineer and Manager, and Lighting Engineer, Chesterfield) was then inducted into the Presidential Chair, and delivered his Address, which was published in the "JOURNAL" last week.

ADMINISTRATION OF PUBLIC LIGHTING.

Following the Presidential Address, a paper was read by Councillor R. H. Minshall (Chairman of the Sub-Committee of Street Lighting, City of Sheffield) on "The Administration of Public Lighting." An extract from this also appeared in the "JOURNAL" last week.

Discussion.

Mr. S. B. LANGLANDS (Lighting Engineer, Glasgow) expressed his thanks for the paper, which came from a man who knew definitely what he wanted and how to go about it. There was, however, one Department interested in public lighting which had not been mentioned—viz., the Cleansing Department—because with adequate public lighting the Cleansing Department could do its work more efficiently.

Alderman BRATHERTON (Salford) complained that the author had stopped at the very point upon which he, as a layman, desired enlightenment—viz., the relative advantages of gas and electricity. That was one of the most important things he had come to the conference to learn something about—but the experts seemed to want to leave it to the laymen to fight that issue out. If the experts could not settle that question, what was going to be done? At present there was an overlapping in the use of electricity and gas which must cost the municipalities a great deal of unnecessary expenditure; and it was for the technical advisers to come to a decision as to which was the best system to adopt in the public interest. Although the author had said he was sick of hearing about so much economy, it was the fact that there must be economy having regard to the present burden of rates; and it would have to be faced whether the author and others with similar views liked it or not.

NO GOVERNMENT INTERFERENCE.

Mr. C. S. SHAPLEY (Gas Engineer, Leeds Corporation) said that, although he would be regarded as a gas man, he nevertheless used a great deal of electricity both for public lighting and on the works; and where it so happened that both electricity and gas were installed in a city it would be waste of money to supplant either the one or the other while they were giving satisfaction to the citizens. The appointment of a special lighting engineer did not by any means ensure that a definite decision would be given in favour of the one or the other. As a matter of fact, both gas and electricity were useful in their particular fields. He joined issue, however, very seriously with the author in regard to his advocacy of the Government coming in with regard to the question of public lighting.

Mr. J. B. BALMFORTH (Bingley) remarked here that, while he agreed there should be no Government interference with public lighting, there should nevertheless be Government financial assistance in that motorists should be made to pay for the lighting of the roads to a greater extent than they do at present. That money should be handed over to the local authorities, by the Government, for better public lighting.

ADVOCACY OF INCREASED EXPENDITURE.

Lieut.-Commander HAYDN T. HARRISON advocated increased expenditure upon public lighting and pointed to the very low cost per head of population in well lighted cities. If only lighting engineers were encouraged in this way they would quickly devise ways and means which would produce very much better results at lower costs. It was a necessity of modern times that public lighting should be improved; and from that point of view it was not important whether it was done by gas or electricity. In any event that issue did not come within the scope of the paper. The position to aim at was adequate public lighting to meet modern needs at the minimum cost; and if only the position was placed before lighting committees in the clear

manner adopted in the paper, there should be no difficulty in getting schemes carried out.

Alderman L. HILL (Leicester), referring to the suggestion that the Government should provide something towards the cost of public lighting through extra taxation on motorists, said that this carried with it the logical result that the Government would desire to have a hand in the supervision of public lighting; and nobody wanted that. As to economy in public lighting, the point should be remembered that there had been a vast improvement in street lighting generally in recent years, and the cost had, at the same time, been reduced for a given result. That was due to more efficient supervision following the appointment of lighting engineers, although the small towns suffered in that they could not afford a special public lighting engineer.

Alderman CHATFIELD (Eastbourne) asked what the author's views would be on the question of gas *versus* electricity if he happened to live in a town where the electricity was in the hands of the municipality and the gas in the hands of a company?

The AUTHOR said that was the position in Sheffield.

EASTBOURNE'S LIGHTING.

Alderman CHATFIELD replied that that was also the position in Eastbourne, where the electric public lighting was administered by a Street Lighting Committee of which the Electrical Engineer was the chief officer. Instead of skating over the issue of whether electricity was better than gas, or *vice versa*, the author should have faced the position and stated the merits and demerits, leaving it for the laymen to make their own decisions. The position seemed to be that the experts were afraid to go at this matter hammer and tongs in an endeavour to prove which was the best; but if they would only do so, he felt convinced that the results would be all to the good.

Councillor T. J. PICKERING (Finsbury) said the motorists could hardly be taxed specially for street lighting, seeing that motor cars lighted the roads as they went along. Perhaps in the future we should have our important roads, at any rate, lighted from beneath the curb, thus doing away with all lamp standards. He agreed that it was false economy not to spend money upon such an essential public service as street lighting as long as the work was carried out efficiently.

GAS *versus* ELECTRICITY.

Alderman H. VARLEY (Chesterfield) expressed his disappointment that the question of gas *versus* electricity had not been gone into in the paper. Electrical engineers, he said, knew exactly where they stood in this matter and did not hesitate to place the position before their conferences, but the atmosphere at this conference of public lighting engineers seemed to be that it was *infra dig.* to compare the merits of electricity and gas. If that were so, then he considered the conference was badly missing its mark, because the lay members of the Association were entitled to know which was the best system. Many thousands of pounds had been spent in Chesterfield on street gas and electric lamps, and he was not in favour of scrapping the gas lamps because the Corporation could not afford to do so. He did not deny that gas had its uses, but generally speaking he regarded gas as second to electricity for street lighting purposes.

Bailie D. DAVEY (Greenock) said the experience in Greenock had been that gas street lighting installations could be installed for about half the cost of electricity there.

Councillor T. S. WILLIAMS (Manchester) referred to the efforts that have been made in Manchester to cut down expenditure, but added that the question of public lighting, being more a matter for experts, had been sent to a special Sub-Committee. Hitherto the cost of street lighting in Manchester had been about £100,000 per annum more than any similar city in the country, but the superintendence of the public lighting was in the hands of a very capable man—Mr. Sellers. Speaking generally, he held the view that there is room for a combination of both electricity and gas for street lighting, at any rate in certain districts; but the great need is expert advice of an impartial character in order that the best results according to the circumstances of the case may be obtained. He doubted whether a special tax on motorists would be effective, because in all probability the Government would deal with it as it had dealt with the Road Fund, and the local authorities would get nothing from it.

Mr. L. T. MINCHIN (Gas Light and Coke Company) suggested that a general discussion on gas *versus* electricity was neither desirable nor advantageous. The two sides of the question were to be dealt with in separate papers on the following day, and then, from a consideration of all the items, it merely remained for each authority to decide which was the best for its particular purpose. A testing laboratory in the case of every undertaking, as suggested in the paper, seemed a little extravagant, and could not be afforded by the smaller undertakings. It would be better to have some central authority which could do this work and deal with both gas and electricity impartially, thus securing authentic results.

Alderman F. H. DWYER (Dewsbury) referred to an investigation of street lighting installations carried out by his Council, and the decision arrived at that central lighting by means of electricity resulted in glare, and that from this point of view gas gave better results.

Councillor J. BYASS (Bridlington) also deprecated any suggestion of Government interference in public lighting, but added there should be some decision come to as to which is the proper standard of street lighting for streets of various classes. The back streets should be lighted as well as the main streets, for the occupiers paid rates on the same scale.

GAS WINS ON COST.

Councillor E. T. FASHAM (Margate) said that his town owned neither the gas nor electricity undertakings, and he felt they were fortunate in their position, because whenever they wanted street lighting carried out they called for tenders from the gas and electricity supply companies, and were able to choose the best at the lowest cost. The experience in Margate had been that gas beat electricity in the matter of cost by 50 p.c. every time.

Dr. J. S. G. THOMAS (South Metropolitan Gas Company) said he did not believe that one single council or committee really knew what they wanted in the matter of street lighting. If only they could state their requirements they could be met either by electricity or gas, although personally he believed there was only one way—viz., gas.

The PRESIDENT, in bringing the discussion to a close, said the paper must be regarded as a picture of idealism. The small authorities could not contemplate the appointment of a special lighting engineer. It must be recognized that expenditure on any system suitable for the particular job would give good results.

Councillor MINSHALL, in his reply to the discussion, said he is an idealist and proud of it, for he believes in what a well-known writer had said that "idealism is the only realism." He had not entered into the controversy of gas *versus* electricity, nor had he skated over the subject as had been suggested, for the simple reason that it was definitely stated in the paper that it would not be discussed. It was a matter upon which experts could not agree. He had once asked a lighting engineer, well known in this country, on the Continent, and in America, which he would adopt—electricity or gas—if no question of cost of any sort entered into the matter; and the reply had been "I should toss up a penny." The paper dealt with administration, and therefore did not include the merits or demerits of gas and electricity. He agreed that separate public lighting engineers could not be appointed for small places, nor that every town could have its own testing laboratory. The suggestion of Mr. Minchin in that connection was valuable.

A cordial vote of thanks was passed to Councillor Minshall at the conclusion of the discussion.

LUNCHEON.

The Association were entertained at luncheon by the Blackpool Corporation after the morning session.

Responding to the toast of "The Association of Public Lighting Engineers," proposed by the MAYOR OF BLACKPOOL,

Mr. R. BEVERIDGE (Past-President) said that when the Association came into existence nine years ago, public lighting in this country had reached a very low ebb indeed. As the result of war conditions economies had been effected, the results of which were not, at the time, fully appreciated. Since the Association had established itself, however, much greater prominence had been given to public lighting than had hitherto been the case; and it was recognized as a public service which had been very much overlooked. The increase in the public lighting and the greater interest taken in the subject in recent years, together with the greater efficiency obtained, were testimony to the activities of the Association.

The PRESIDENT proposed "The Corporation of Blackpool," which was responded to by Councillor THOMAS PYE (Chairman of the Blackpool Lighting Committee).

ANNUAL GENERAL MEETING.

At the opening of the Annual General Meeting of the Association on Sept. 7 the President handed to the Retiring President (Mr. R. Beveridge, Edinburgh) the Certificate and Badge of the Retiring President, and, at the same time, expressed the thanks of the members to Mr. Beveridge for his work during the past twelve months.

Mr. E. J. STEWART (Hon. Editor) then presented the Annual Report of the Council for the past year, and expressed the indebtedness of the Association to those members who had sent in reports with regard to the public lighting in their districts. He also expressed the hope that a larger number of members would in future send in such reports for inclusion in the Annual Report of the Council.

Mr. H. C. BROWN (Hon. Treasurer) presented the Accounts, which he said must be regarded as satisfactory.

Mr. W. J. JEFFERY (Charing Cross Electricity Supply Company), moving the adoption of the Report, said that while the work was progressing in a satisfactory manner it was to be regretted that a larger number of public lighting authorities were not members of the Association; and he expressed the hope that a special effort would be made during the coming year to increase the membership. In moving a vote of thanks to the Council, Mr. Brown specially mentioned the work done by the Hon. Secretary, Mr. Dow.

The PRESIDENT made a special appeal to all members to send to the Hon. Secretary copies of the annual reports which they present to their authorities, in order that the information might be embodied in the Annual Report of the Council.

The Report and Accounts were then unanimously adopted.

The result of the ballot for election of Vice-President and Members of Council was as follows:

Vice-President.—Mr. E. M. Severn (South Metropolitan Gas Company).

Members of Council.—Mr. E. C. Lennox (Newcastle-upon-Tyne Electric Supply Company); Mr. C. H. Woodward (Bournemouth Corporation); Mr. C. S. Shapley (Gas Engineer, Leeds Corporation); Mr. J. H. Clegg (Gas Engineer, Burnley).

It was unanimously decided to accept an invitation to hold the 1933 Conference in Margate.

A cordial vote of thanks was passed to the Blackpool Corporation and its officials for the arrangements made in connection with the conference this year.

The PRESIDENT announced that Mr. S. B. Langlands had offered a medal or award in some form for the reader of the best paper at the conference.

It was decided to leave the award in the hands of the Council.

THE ASSOCIATION LUNCHEON.

This was held in the Imperial Hotel.

Mr. S. B. LANGLANDS proposed "Our President," and referred with satisfaction to the work he had done for the Association and the fact that the conference had drawn a record attendance.

The PRESIDENT briefly responded.

Mr. J. F. COLQUHOUN (Sheffield) proposed "Our Guests," and again expressed the thanks of the Association to the Mayor and Corporation of Blackpool and their officers for all they had done to make the conference a success. He also made special reference to the presence of Mr. C. C. Paterson.

Alderman J. P. SANDERSON (Chairman of the Gas Committee, Blackpool), who responded to the toast, said that the Highways Sub-Committee controlled the street lighting in Blackpool, and that the Electricity and Gas Committees worked very amicably in ensuring effective and efficient street lighting in the town. At present there were 5000 gas lamps and 3000 electric lamps in the streets, and great attention was being paid to the lighting of the back streets. Gas was being supplied for street lighting at 6½d. per therm and electricity at 1½d. per unit, and there was every intention of adding considerably to the number of street lamps at present in use. Finally, he urged that where a town is of sufficient size, they would be well advised to have a whole-time public lighting engineer.

FINAL SESSION.

The final session of the conference was held in the afternoon, when the President was again in the chair, and the following three papers were read: "The Public Lighting of Colchester," by H. Collins; "Street Lighting in Burnley," by J. H. Clegg; and "The Street Lighting of Oldham," by I. H. Massey. Abstracts of all these papers were published in the "JOURNAL" last week.

Discussion.

Mr. C. I WINSTONE (Gas Light and Coke Company), referring to the wonderful mantle averages obtained by Mr. Clegg—viz., 1½ mantles per nozzle per annum—said his figure was about 4 per nozzle per annum; but in making any comparison it was necessary to know all the conditions, whether the lamps were cleaned every week, and whether the burners were taken out and cleaned at stated intervals. Again, the fact of whether the lamps were clock controlled or hand lighted had to be taken into account. Mr. Clegg had mentioned 16-day clocks, but he himself had purchased some clocks guaranteed to go for 21 days, which had an advantage. With 16-day clocks and fortnightly cleanings, when the clock got old the spring became sluggish, and as the spring lost its tension the clock lost time. With 21-day clocks, however, there was a week's tension on the spring to assist the clock to keep good time at the end of a fortnight. There was one statement in the paper by Mr. Clegg which could not possibly be true—viz., in the letter quoted from Dr. Myres to the effect that in certain circumstances a person on a road would be indistinguishable when the central lighting system was used. Dr. Myres was advocating staggered lighting as against central suspension, but it was possible to prove from actual experience that the opposite was the case. For instance, on the Victoria Embankment it was easily possible to see a person between two lamps, and the same applied to the overhead gas lighting installation in Oxford Street. There it was possible to see a person a quarter of a mile away between two lamps. After all, it was the roadways rather than the footways that should be lighted most, because it was on the roads that so many accidents occurred; and it was in this connection that the central system of lighting had so much advantage.

A POINT OF DISAPPEARANCE.

Mr. L. T. MINCHIN (Gas Light and Coke Company) said that, although Dr. Myres had taken a rather extreme view of this matter, it was possible for spots to exist in a roadway where a person might disappear suddenly where the conditions of lighting were not too good. This arose because of the fact that in London, at any rate, there was a sheen on the surface of the roadway which caused the background to be constantly changing, and this was a point upon which some research was necessary. It was possible to have a dark channel between two lamps in which a person might disappear. At the same time Dr. Myres must have been taking an extreme case and arguing from theoretical considerations. Nevertheless, it might happen on the matt surface of a concrete road.

Councillor E. H. SHORROCKS (Oldham) expressed his appreciation of the information contained in the three papers and commented on the improvement brought about in the smaller towns in regard to public lighting in recent years.

CENTRALLY SUSPENDED LIGHTING.

Capt. W. J. LIBERTY said that, as a member of the Research Committee which dealt with street accidents, he had had a bit of a shock when he read in Mr. Massey's paper that a pedestrian in his town ought to go to a particular point before he could safely cross the road. If that were really necessary, he could not help feeling that Mr. Massey had made a mistake with his spacings. If the spacings were correct, then it was not necessary for the pedestrian to have to take such a precaution. In the case of the centrally suspended lighting in the City of London, for which he was responsible—and of which two-thirds was gas and one-third electricity—he found he had practically a shadowless road; and a member of the Lighting Association of America had told him that these streets conformed to three important points—viz., it was possible to pick up a pin in the centre of the road; it was possible to walk along the streets and read a newspaper at any point between the lamps; and, finally, it was possible to read the index number of a motor-car passing by. If these three requirements applied in the case of central lighting, whether by electricity or gas, said Capt. Liberty, then there was no need for the pedestrian to go to a certain point to cross the road.

Lieut.-Commander HAYDN T. HARRISON congratulated all three authors on the valuable information contained in their papers inasmuch as they gave practical results of well carried out schemes. A great deal was heard about the lighting of the large cities but not enough about the smaller towns, which represented probably 80 p.ct. of the public lighting in the country; and it was for this reason that the three authors were specially to be thanked.

Mr. T. WILKIE (Leicester) suggested that the smaller authorities should consider extending their street lighting in the summer time, with the object of reducing street accidents.

This latter point was supported by another speaker, who deprecated the policy of leaving the public lamps out during the period of full moon. He also instanced the case of a large city which sent all its lamplighters for a week's holiday, and had no public lighting during that time. This same speaker added that in Weston-super-Mare the mantle consumption per nozzle per annum is less than 1.

The PRESIDENT said the towns chosen for the papers had not been selected in any way as models, but merely as typical towns of their size, in the hope that from the work done there it would be possible for others to find something of interest. Even the authors would not suggest that their standard was the highest, and they would probably wish to do better. The question of all-night lighting in the smaller towns was one of cost, and a decision in the matter had also to be guided by the nature of the traffic. At the same time, there was the point that the gas and electricity authorities should be prevailed upon to supply at a very much lower price during the night hours, when the load on their stations was a minimum. Again, the question of whether a Corporation was allowed to make profits for the relief of rates made a difference, and where that was the case it simply meant that any profits made from the public lighting went back to the ratepayers, so that the final result would not be very different. Where companies were giving the supply, however, he contended there was a substantial case for asking for very low rates for energy for lighting during the night hours after the main demand was off. Neither of the towns dealt with in the papers had gone in for automatic lighting, but his advice was that if automatic lighting was adopted it should be adopted completely throughout, and not piecemeal. His own experience was that the savings in wages more than outweighed the cost of the clocks in a period of five years. In Chesterfield the failures of lighting due to the clocks was not 0·5 p.ct. It was stated by Mr. Collins, of Colchester, that he used 4 c.ft. of gas for two bijou mantles; but as a gas engineer he maintained that it was absolutely impossible to light two normal bijou burners with less than 2½ c.ft. each without losing a great deal of efficiency. In all probability the Gas Company in Colchester was using 2½ c.ft. per burner, but was charging for 2 c.ft., which was in effect a 20 p.ct. reduction.

Mr. COLLINS, in his reply, said that the figure of 2 c.ft. per bijou mantle was one agreed with the Gas Company.

Mr. MASSEY said that in Oldham there is no cutting-off of the street lamps in the summer so far as the main roads are concerned. The charge for the gas street lamps was on the basis of 1½ c.ft. per mantle, but it did not pay the Department.

Mr. CLEGG agreed that Dr. Myres must have been regarding the question of a man disappearing from view in a well-lighted thoroughfare from the theoretical standpoint. The point was that this could only happen when the light on the individual was the same as on the roadway and when the reflections were the same, but one could hardly expect the reflections from an individual to be the same as those given by the roadway against which he was standing. As to the criticism of his mantle consumption, it had been also stated in the discussion that even better figures had been obtained, so that this disposed of the suggestion that his figures were unduly low.

Gas Appliances—Arrangement and Ventilation*

By A. Tyler, M.R.San.I., M.S.I.A., Sanitary Inspector, City of London

Just as drains, if improperly constructed, electrical installations wrongly arranged, or water supplies subjected to pollution, are likely to give rise to danger, so also is gas if carelessly installed.

Gas fitting by incompetent persons and the use of unsatisfactory appliances should be prohibited, and the policy adopted by most gas companies should be enforced—*i.e.*, skilled gasfitters and properly tested appliances. At present, obsolete and unsatisfactory fittings can be purchased from secondhand shops and stalls, with the result that, where cost is the primary consideration, such fittings are bought and installed, usually in an unsatisfactory manner, with obvious results.

Gas appliances are safe, if of reputable manufacture, correctly installed, contained in well-ventilated rooms, and properly used by the consumers; but non-observance of these essentials may lead to injury to health or perhaps danger to life. In drainage systems only approved types of materials and fittings are permitted. Why not similar restrictions in regard to gas systems?

In 1931 a Departmental Committee of the Board of Trade reported that " during the period 1918 to 1928, 1602 deaths in Great Britain were ascribed to gas poisoning as a result of accidents, and 7316 from suicides by gas poisoning." Probably some of those recorded as accidents were also suicides, but in any case, considering that in 1928 there were nearly nine million gas consumers, there is no need for alarm. Nevertheless, no effort should be spared by all concerned to bring about conditions which would eliminate the risk of such accidents.

Whether the percentage of CO contained in public gas supplies should be limited was considered by the Departmental Committee, but they considered such limitation as unnecessary. It is not so much the percentage of CO contained in the gas, as the proper combustion of the gas when used, that is most important. If perfect combustion is not obtained, CO will be present in the products of combustion, and unless the room is adequately ventilated, conditions of discomfort and perhaps danger will arise.

Incomplete combustion is usually due either to inadequate supply of air to the burning gas, or to the non-aerated flames coming into contact with relatively cold surfaces. Both of these conditions can be avoided.

The following conditions may be observed when inspecting premises:

Leakages from Mains and Service Pipes.

The Ministry of Health have drawn attention to the danger of leaving holes in walls, below the ground level. These holes are often made for the purpose of laying gas, water, or electric services, and unless filled in at the completion of the work provide suitable means of ingress for any gas which might leak from mains in the adjoining roadway. In view of this danger we should see that when the laying of drains, renovating of damp proof courses, underpinning, &c., are carried out under our supervision, that holes cut through the walls are made good afterwards.

Occasionally danger arises from the laying of electric cables in close proximity to gas pipes, the latter becoming perforated and gas leakage set up. When supervising internal repairs, especially when floors are taken up, we might note if this arrangement exists, and if so the local gas and electricity companies should be notified.

Fixtures.

Chandeliers.—Water slide type are obsolete and should be replaced by more suitable fittings. The water forming the seal may evaporate and so allow gas to escape.

Brackets.—May be cracked and leaky, or become strained and broken through being used as coathangers, &c.

Taps.—Loose or badly worn. If without stop-pins may be left at the " on " position when thought to be turned off.

Burners.—If luminous type, contact with cold surfaces should be avoided. Obsolete types do not possess means of regulation. If aerated type, correct proportioning of gas and air is essential. If gas rate is excessive, combustion may not be complete.

Connections.—Use of flexible tubing sometimes unavoidable. It is essential to have suitable type. Ordinary rubber tubing may become burnt, kinked, or perished. " Slip-on " connections to the appliance and gas point are dangerous as they may easily become detached. Wing-nut unions, bayonet taps, or other suitable connections should be used.

Unsuitable Positions for Appliances.

Position chosen is usually in regard to obtaining maximum thermal efficiency, but hygienic importance must never be sacrificed for thermal efficiency. Though the position is suitable at time of installation, consumers often move appliances to new positions, especially in workshops, where appliances are frequently seen placed on benches, with a length of rubber tubing connecting them to gas points. I have seen gas fires placed on wall brackets, office desks, warehouse counters, &c. Position should always be such that products of imperfect combustion will be effectually removed from the room.

Appliances Commonly Used.

Fires.—Before substituting a gas fire for a coal fire in an existing fireplace, test ventilating efficiency of chimney. If downblow is probable, the flue pipe should be extended upwards into chimney and terminated with a cone. It is claimed that if the flue spigot of a modern gas fire is connected to a normal flue, the products of combustion are easily removed, and that a baffle is unnecessary. With all types, good ventilation of room is essential. Flames should pass up centre of radiants, and broken radiants should be renewed.

Radiators.—Although these appliances set up a certain amount of convection currents, they cannot be regarded as heaters and ventilators. They sometimes smell badly and cause overheating of the atmosphere. It is frequently observed that when these radiators are installed the fireplaces are sealed up. This should not be permitted unless other adequate permanent means of ventilation exists. Having no flue for carrying away products of combustion, only modern types, possessing a governor to control gas consumption and a thermostat to ensure equable temperature, should be used.

Cookers.—In hotel and restaurant kitchens where large cookers or a series of cookers are used, a hood should be provided, with a flue pipe connected to the chimney or outside air. Ordinary domestic cookers, unless contained in badly ventilated rooms, do not require a flue pipe.

Wash-boilers.—Old types with loosely fitted gas ring and rubber tubing connection are unsatisfactory. Adequate ventilation of washhouse is essential. In addition to products of combustion large volumes of steam must be removed.

Bathroom geysers.—Having to supply large volumes of hot water on demand, the gas consumption is necessarily high. Therefore, to prevent overheating and stuffiness in the bathroom, and to carry away the products of combustion, a flue pipe is necessary. The flue pipe should be of same cross sectional area as the geyser socket into which it fits. In some districts the flue pipe connects direct to the geyser, while in others it is disconnected and a cone fixed at the bottom. There appears to be a controversy as to whether this is an advantage. A flue pipe may be of metal or asbestos cement, the latter having the advantage of being less affected by corrosion when used outdoors. Square elbows should not be used as they restrict pull and collect rust. Round elbows or obtuse bends are best.

Having fixed a flue pipe, it is necessary to guard against downblow. For this purpose a baffler is fitted. It must not only prevent downblow, but also facilitate the removal of the products of combustion. Some authorities fit the baffler as high as possible on the flue pipe, while others prefer a position near the geyser. The former method agrees with the Ministry of Health's suggestions, while practical tests have proved the other arrangement to be efficient. It would be better, however, if gas companies were uniform in their methods.

The flue pipe and baffler being fitted, the position and method of terminating the flue pipe must be considered. Each case should be decided according to the circumstances. Positions where the effect of adverse winds are likely should be avoided—*e.g.*, under the eaves, or in angles formed by the walls of the building. The best position is above the eaves, but with suitable terminals other positions are often efficient. Precautions should be taken to guard against birds building their nests in terminals. Where the flue pipe is connected to a chimney, it should terminate flush with the internal surface of the chimney, and the joint should be made with fireproof cement. If terminated in roof space, precautions against risk of fire are essential.

Until a few years ago it was customary, if a flue pipe was

* From a paper before the Sanitary Inspectors' Association, Annual Conference, Colwyn Bay, Sept. 7, 1932.

fitted, to carry it through the wall, fit an upturned square elbow, and terminate with a cone or T piece, but experience has proved such an arrangement to be inefficient.

The provision of a flue pipe, baffle, and terminal, each of approved type, should be compulsory and not optional.

Bathroom Ventilation.

In some instances it is claimed that sufficient air is admitted under the door, the provision of additional air inlets being unnecessary, but bearing in mind that, in addition to the products of combustion, large volumes of steam are present in the bathroom, conditions must be such that an adequate supply of fresh air is essential if discomfort and danger are to be avoided. The judicious placing of air-bricks is usually sufficient, while the provision of Sheringham's valves, louvres, or even Tobin's tubes may be worthy of consideration. The time may arrive when the bathroom will have its own air shaft. Bathrooms should always have a window of adequate size opening directly to the external air.

Multiple Gas Appliances.

It is necessary in some workshops to have a number of appliances in use at the same time. Wherever possible, they should be grouped together under a hood, which should have a flue pipe connected to a chimney or the outside air. Where it is impracticable to group these appliances, a cone may be fitted over each appliance, each cone having a flue pipe and the various flue pipes being connected to a main flue pipe or hood. Hoods and cones must be fixed at the correct height, otherwise products of combustion may be disseminated about the room as the result of cross currents of air from doors or windows. If existing hoods are too high, apron pieces of the required length will provide a remedy.

Rooms Without Flues.

Gas appliances are sometimes installed in rooms not possessing flues. Instances of this are often the result of the housing shortage, rooms originally intended only for use as boxrooms having been converted into use as living rooms or bedrooms. This practice should not be permitted, but far from this being the outlook, the practice has extended, many new houses having been built, containing rooms not provided with flues. Presumably, it was expected that the occupiers would have had electricity installed—though it is inconceivable why even this should warrant the absence of flues—instead of which they have had gas laid on. Our esteemed President, Sir Leonard Hill, has already warned local authorities of this danger, and in Circular 1133, Gas Poisoning, the Ministry of Health explains how local authorities may deal with this problem. The wording of Appendix II. is, however, rather ambiguous, viz.: "*Every person who shall erect a new domestic building and shall*, for the purpose of heating any habitable room therein, *provide a gas fire or other similar apparatus*, shall for securing the ventilation of the room construct an adequate flue in connection with such gas fire or apparatus." What is the position if he does not provide a gas fire?

Conclusion.

Sufficient has been said, perhaps, to indicate that the arrangement of gas appliances should be regarded as a public health problem.

There is no reason why the use of gas should be accompanied by danger or injury to health, but ignorance or neglect by consumers, installation of appliances by other than competent gasfitters, the lack of appreciation of elementary details regarding ventilation, and the sale of obsolete and unsatisfactory appliances and materials, all tend to create imperfections in a system which can and should be made much safer.

The two important factors are perfect combustion and adequate ventilation. If combustion is incomplete, the aqueous vapour in the room will be increased and the atmosphere further polluted with CO_2 and CO, and although it is claimed that the concentration of CO found in the flue gases at the flue outlet of modern gas fires is often less than that found in the air of certain London streets, that is no justification for people in their homes, offices, or workshops being subjected to conditions injurious to their health.

It is not suggested that fatalities will be frequent. The object is rather to focus attention to those cases where persons are subjected to the effects of minute leakages of gas or CO over long periods, the aggregate effect being just as serious from a public health point of view.

In addition to the physiological aspect, there is an economic aspect, for it is reasonable to assume that workers under such conditions will become less efficient.

There is a good field for practical efforts by our members. Some inspectors already use the Kata thermometer for testing the cooling power of atmospheres. Its use should become more general, while the sampling of air in workshops would probably sometimes reveal that the CO content was of greater importance than the percentage of CO_2. Tests of this kind would be more convincing than to tell an employer that his workshop was stuffy, or relying upon discomfort as a deciding factor.

Active co-operation between gas companies and ourselves would have far-reaching effects, and the health of the public would benefit as a result.

Corporation Undertakings' Results

Chelmsford.

The year's trading to March 31 last resulted in a net profit of £3534. The total increase in sales for the previous year, including public lighting, was 9,175,000 c.ft., or an increase of 4·47 p.ct. The increase in gas output is principally due to gas sold through ordinary meters. Sales through slot meters show a relatively small increase, due, no doubt, to the effect of the industrial depression on the smaller households. But for this factor and the mildness of the weather during the winter months, a larger increase might have been expected. The average sale per consumer again shows an increase. During the year electrical competition in Chelmsford has been more intense with the availability of the grid supply. The introduction of a coke grading plant during the winter has not only lessened handling costs but improved the sizing of the coke considerably; and it was possible to dispose of the whole of the production and most of the stock by the financial year end.

Greenock.

During the year the capital account was increased by £7844, due to expenditure on main and service pipes, meters, stoves, and the purchase of an old property. At May 15, 1932, the total capital expenditure on works and plant amounted to £435,067, being equal to £657·20 per million c.ft. of gas made compared with £427,223 and £620·96 per million at May 15, 1931. The quantity of coal carbonized during the past year was 32,418 tons, as compared with 32,694 tons for the preceding year, a decrease of 276 tons. Compared with the quantity used in 1914 the decrease in 1932 is no less than 10,094 tons. If the carbonizing results at Inchgreen to-day were similar to those of 1914, 67,207 tons of coal would have been used as compared with only 32,418 tons, a saving of 34,789 tons per annum. The quantity of gas made during the past year was 661,720,000 c.ft., equal to 2,713,052 therms, compared with 688,499,000 c.ft., or 2,822,846 therms, for the preceding year, a decrease of 26,779,000 c.ft., or 109,794 therms. Compared with 1914 the increase in gas made is no less than 243,109,000 c.ft., or 58·08 p.ct. The quantity of steamed vertical retort gas made per ton of coal carbonized was 20,412 c.ft., or 83·7 therms, compared with 21,059 c.ft., or 86·3 therms of gas for the preceding year. The quantity of gas delivered and accounted for during the year amounted to 629,477,400 c.ft., or 2,580,857 therms, as compared with 674,268,400 c.ft., or 2,764,500 therms for the preceding year, a decrease of 44,791,000 c.ft., or 183,643 therms. The unaccounted-for gas during the year was 4·87 p.ct. as compared with 2·07 p.ct. for the preceding year, an increase of 2·80 p.ct. The net sum realized from the sale of coke and breeze amounted to £9844, being £1169 less than in the preceding year. The total quantity of coke and breeze available for sale was 12,651 tons compared with 12,810 tons for the previous year, a decrease of 159 tons. The net sum realized from the sale of tar was £4858 as compared with £5158 for the preceding year, a decrease of £300. The total quantity of tar available for sale was 615,683 gallons compared with 666,361 gallons for the preceding year, a decrease of 50,678 gallons.

Oldbury.

The accounts of the Oldbury Gas Undertaking for the year ended March 31, 1932, show that the total income for the year was £52,556, as compared with £53,961 last year—a decrease of £1405. The gross profit amounted to £11,210, as compared with £11,715 last year—a decrease of £505. After payment of all the charges there was a net loss of £2773, as against a net profit of £1267 last year. The Chairman of the Committee said the depression which the country had been going through had been keenly felt by the gas-works. The sales of gas showed that for domestic purposes they had well maintained their sales, but for industrial purposes they were down by the amount of about £2400. They would find, however, that the gross profit had only gone down by £506, for which the Gas Manager and staff ought to be congratulated.

GAS MARKETS & MANUFACTURES

Stock Market Report.

[For Stock and Share List, see later page.]

The outstanding feature on the Stock Exchange last week was the large increase in buying orders from the investing public, indicated by the reports from brokers that the bulk of the business done was in comparatively small lots. Nearly all markets were affected, but more especially the mining and industrial sections. British Funds were steady throughout, and some showed fractional improvements on the week.

As is usual when the more speculative counters are in demand, the volume of business in the Gas Market was not quite so heavy last week. Prices generally remained about the same, though some reaction was noticeable in a few leading ordinaries. European continued its upward movement with a further 2 points rise to 117 (*cum* div.), and on the Bristol Exchange Newport (Mon.) gained 1 point to 87.

At an extraordinary general meeting of the Commercial Gas Company held on Thursday last a resolution was unanimously passed authorizing the Directors to create and issue new 5 p.ct. debenture stock. It is not the Board's intention to issue this stock for fresh money, but to enable them to carry into effect the provisions contained in the Company's Act of 1932 which authorizes the exchange of ordinary stock for 5 p.ct. debenture stock, the nominal amount of ordinary stock to be exchanged not to exceed the sum of £350,000. The operation is a novel one, but fully justified when comparing the proportion of the Company's existing fixed-interest stock to ordinary capital. This is 19 p.ct. only, as against Wandsworth's 34 p.ct., Gas Light and Coke and Croydon 32 p.ct., Tottenham 28 p.ct., and South Metropolitan and South Suburban 27 p.ct. The basis of the exchange, which is entirely optional on the part of the stockholders, is in the proportion of £100 ordinary stock for £96 debenture stock. The new stock will be a first charge on the profits of the Company, ranking equally with the existing 3 p.ct. debenture stock, and is irredeemable. Interest is payable half-yearly on March 1 and Sept. 1, the first six months' interest being payable on March 1 and Sept. 1, the first six months' interest being payable on March 1 next.

Having regard to the present market value of the existing stock it would appear that some substantial capital appreciation should accrue. The price of the 3 p.ct. debenture is 72½, so that proportionately the value of the new 5 p.ct. debenture would be about 116 for the £96 offered in exchange for the ordinary, which now stands at 104½ p.ct. Those requiring added security will doubtless have no hesitation in changing over to the new stock. The list for applications closes on Sept. 30, or at an earlier date if applications are received for the full amount.

Current Sales of Gas Products.

The London Market for Tar Products.

LONDON, *Sept.* 12.

The prices of tar products for the current week are as follows: Pitch, 95s. to 97s. 6d. per ton f.o.b.

Creosote, 3½d. to 5d. per gallon f.o.b., according to specification.

Refined tar is 4d. to 4¼d. per gallon in bulk at makers' works.

Pure toluole is about 2s. 5d.; pure benzole, about 1s. 8d.; 95/160 solvent naphtha, 1s. 4½d. to 1s. 5d.; and 90/140 pyridine bases, 3s. 9d. to 4s.—all per gallon naked at makers' works.

Tar and Tar Products in the Provinces.

Sept. 12.

The average prices of gas-works products during the week were: Gas-works tar, 34s. 6d. to 39s. 6d. Pitch—East Coast, 85s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 85s. f.o.b.* Toluole, naked, North, 1s. 7½d. to 1s. 9d. Coal-tar crude naphtha, in bulk, North, 5d. to 5¼d. Solvent naphtha, naked, North, 1s. 2½d. to 1s. 3d. Heavy naphtha, North, 10¾d. to 11d. Creosote, *ex* works, in bulk, North, liquid and salty, 2½d. to 3d.; low gravity, 1¼d.; Scotland, 2½d. to 3d. Heavy oils, in bulk, North, 4¾d. to 5¼d. Carbolic acid, 60's, 1s. 7d. to 1s. 7½d. Naphthalene, £9 to £10. Salts, 55s. to 75s., bags included. Anthracene, "A" quality, 2½d. per minimum 40 p.ct., purely nominal; "B" quality, unsaleable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Sept.* 10.

While pitch remains firm in tone, other products are rather weak, with prices easy.

Crude gas-works tar.—Actual value is 50s. to 52s. 6d. per ton *ex* works.

Pitch.—Supplies are scarce, and quotations for export are round 85s. to 90s. per ton f.o.b. Glasogw. Home value is 90s. to 100s. per ton *ex* works, according to quality.

Refined tar to Ministry of Transport Specification is slow although value is unchanged at 4¼d. to 4½d. per gallon f.o.r. in buyers' packages.

Creosote oil.—A small but steady business is being conducted in the home market. B.E.S.A. Specification is 3½d. to 3¾d. per gallon; low gravity, 3¾d. to 4d. per gallon; and neutral oil, 3¾d. to 4d. per gallon; all *ex* works in bulk.

Cresylic acid.—Business is difficult with values nominal. Pale, 97/99 p.ct., is 1s. to 1s. 1d. per gallon; dark, 97/99 p.ct., 11d. to 1s. per gallon; and pale, 99/100 p.ct., 1s. 2d. to 1s. 3d. per gallon; all f.o.r. in buyers' packages.

Solvent naphtha.—Quotations remain at 1s. 2d. to 1s. 3d. per gallon for 90/160 grade, and 11d. to 1s. per gallon for 90/190 grade.

Crude naphtha.—Available supplies are valued at 4½d. to 5d. per gallon, according to quality.

Motor benzole.—There is little activity at quoted price of 1s. 2½d. to 1s. 3½d. per gallon *ex* works in bulk.

Pyridines.—90/160 grade is 3s. to 3s. 3d. per gallon, and 90/140 grade 3s. 3d. to 3s. 6d. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time.

	s. d.		s. d.	
Crude benzole	0 8½	to	0 9	per gallon at works
Motor ,, ...	1 3½	,,	1 4	,, ,, ,,
Pure ,, ...	1 7	,,	1 8	,, ,, ,,

Contracts Advertised To-Day.

Coal.

The Directors of the Newton Gas and Coke Company invite tenders for the supply of coal. [Advert. on p. 598.]

Gas Companies' Results.

Cleveland.

The profit made by the Cleveland Gas Company during the half-year to June 30, 1932, after expending the sum of £81 in repairing damage due to floods in May, 1932, has been £732, to which must be added the amount brought forward from last half-year (£3686), making the balance at the credit of the profit and loss account £4418. This sum the Directors propose should be disposed of as follows: In paying a dividend at the rate of 2½ p.ct. per annum (less Income Tax) for the half-year; in reserving for renewal of carbonizing plant damaged by recent floods £375, leaving to be carried forward to next half-year's account the sum of £3545.

Shrewsbury.

The Annual Meeting of the Shrewsbury Gas Light Company was held at the Company's Offices at Pride Hill. The annual report of the Directors for the year ended June 30 stated that the gross profit on the revenue account amounted to £9364. After allowing for the interim dividend of 2½ p.ct. (less tax) paid in March last, and the interest on mortgages for the year, the balance of net profit available amounted to £12,456. The Directors recommended that a final dividend of 4¼ p.ct. (less tax), making 6¾ p.ct. (less tax) for the year, be declared, payable on and after Sept. 2, 1932. The reserve fund now stood at £13,334. New carbonizing plant had been installed at the north works, together with the necessary auxiliary plant and machinery. The cost of this work had been divided between capital account, special purposes fund, and renewal fund. There had been a decrease of a little over 1½ p.ct. in the sales of gas during the year, due to the general business depression. The number of cookers on hire at June 30 was 5104, together with 2226 fires and radiators. There were also 3340 ordinary and 6413 prepayment meters in use. In addition, the total sales of gas cookers, fires, water heaters, &c., amounted to 660. Mr. R. D. Bromley, Chairman of Directors, in submitting the annual report, referred to the question of street lighting and to the 3075 gas lamps in the City of Westminster—in some of the most important streets in that city. He read again in the "GAS JOURNAL" that there were, according to the annual report of the Liverpool City Lighting Engineers, 661 miles of streets lit with gas in Liverpool. These things seemed to him to show that for street lighting gas was giving good service. There were over 3000 uses for gas in trades. That was something that in more normal times would bring a very great increase to the Gas Industry.

STOCK AND SHARE LIST.

Official Quotations on the London and Provincial Stock Exchanges.

[For Stock Market Report, see earlier pages.]

Issue	Share.	When ex-Dividend.	Dividends. Prev. Hf. Yr.	Dividends. Last Hf. Yr.	NAME.	Quotations. Sept. 9.	Rise or Fall on Week.	Transactions. Lowest and Highest Prices During the Week.
£			% p.a.	% p.a.				
1,551,868	Stk.	Apl. 4	7⅞	7⅞	Alliance & Dublin Ord. ...	100—110	...	109⅝
374,000	,,	July 4	4	4	Do. 4 p.c. Deb. ...	80—90	...	
557,655	,,	Aug. 22	7	7	Barnet Ord. 7 p.c.	132—142	...	135 - 137½
300,000	1	Apl. 29	1/4½	1/9⅞	Bombay, Ltd.	1⅞—1¹⁵⁄₁₆	...	20/- - 20/6
177,750	Stk.	Aug. 22	9	9½	Bournemouth sliding scale	177—187	...	...
550,050	,,	,,	7	7	Do. 7 p.c. max. ...	134—144	...	...
439,160	,,	,,	6	6	Do. 6 p.c. Pref. ...	128—133	...	...
50,000	,,	June 20	3	3	Do. 3 p.c. Deb. ...	70—75	...	71—72½
162,025	,,	,,	4	4	Do. 4 p.c. Deb. ...	90—95	...	94½—97
210,000	,,	,,	5	5	Do. 5 p.c. Deb. ...	115—120	...	...
357,900	,,	Aug. 22	7½	7½	Brighton, Hove, & Worthing 6 p.c. Con. ...	135—145	...	...
540,000	,,	,,	6½	6½	Do. 5 p.c. Con. ...	120—130	...	...
195,590	,,	,,	6	6	Do. 6 p.c. B Pref.	127—132	...	...
1,287,500	,,	Aug. 8	5	5	Bristol 5 p.c. max.	106—108*a*	−1	...
120,420	,,	June 20	4	4	Do. 1st 4 p.c. Deb. ...	92—94*a*	...	...
217,870	,,	,,	4	4	Do. 2nd 4 p.c. Deb. ...	90—94*a*	...	...
328,790	,,	,,	5	5	Do. 5 p.c. Deb.	115—120*a*	...	...
855,000	,,	Apl. 4	7	8	British Ord.	130—140	...	133
100,000	,,	June 20	7	7	Do. 7 p.c. Pref.	120—130	...	...
350,000	,,	—	—	—	Do. 5½ p.c. Pref. ...	107—112	...	...
120,000	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	87—92	...	...
450,000	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	105—115	...	...
160,000	,,	July 4	5	5	Cambridge 5 p.c. Deb. ...	114—119	...	...
100,000	10	May 23	6	6	Cape Town, Ltd.	7½—8½	...	...
100,000	10	Apl. 29	4½	4½	Do. 4½ p.c. Pref. ...	6—7	...	...
150,000	Stk.	June 20	4½	4½	Do. 4½ p.c. Deb. ...	87—92	...	...
626,860	,,	Aug. 8	6	6	Cardiff Con. Ord.	98—103	...	...
237,860	,,	July 4	2½	5	Do. 5 p.c. Red. Deb.	105—110	...	...
157,150	,,	Aug. 8	6½	5	Chester 5 p.c. Ord.	89—94*b*	...	...
98,936	1	May 23	2/-	2/-	Colombo, Ltd. Ord.... ...	26/—31/-	...	...
24,500	1	,,	1/4⅛	1/4⅛	Do. 7 p.c. Pref.	18/—20/-	...	...
609,204	1	Apl. 4	-/10'90	-/11'47	Colonial Gas Assn. Ltd. Ord.	10/—15/-	...	...
296,053	1	,,	1/2·54	1/3·30	Do. 8 p.c. Pref.	10/—15/-	...	...
2,078,280	Stk.	Aug. 8	5½	5	Commercial Ord.	102—107	...	...
475,000	,,	June 20	3	3	Do. 3 p.c. Deb. ...	70—75	...	...
607,560	,,	Aug. 8	7	7	Croydon sliding scale	130—140	...	131
469,590	,,	,,	5	5	Do. max. div.	95—100	...	...
500,000	,,	July 4	5	5	Do. 5 p.c. Deb.	115—120	...	116—119½
542,270	,,	Aug. 8	10	7	Derby Con.	120—130*c*	...	...
55,000	,,	July 4	4	4	Do. 4 p.c. Deb.	75—85*c*	...	...
209,000	,,	Sept. 5	5	5	East Hull Ord. 5 p.c.	93—98*c*	−2	...
179,500	,,	Aug. 22	5½	6	East Surrey Ord. 5 p.c.	108—118	...	...
155,019	,,	June 20	5	5	Do. 5 p.c. Deb. ...	114—119	...	...
1,002,180	,,	Mar. 14	†4	†6½	European, Ltd.	112—122	+2	115—121
19,405,992	,,	Aug. 8	5⅝	5⅝	Gas Light & Coke 4 p.c. Ord.	22/—24/-*g*	...	22/1½—22/6
2,600,000	,,	,,	3½	3½	Do. 3½ p.c. max. ...	77—82	...	77—78
4,477,106	,,	,,	4	4	Do. 4 p.c. Con. Pref.	95—100	...	97½—98½
6,102,497	,,	June 20	3	3	Do. 3 p.c. Con. Deb.	75—80	...	75—78
3,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb.	108—113	...	110½—112
2,500,000	,,	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	105—110	...	106½—107½
264,011	,,	Aug. 22	—	6	Harrogate New Cons. ...	104—109	...	...
82,500	,,	Aug. 22	7	7	Hastings & St. L. 5 p.c. Conv.	118—128	...	...
258,740	,,	,,	5½	5½	Do. 3½ p.c. Conv.	88—93	...	...
70,000	10	June 6	†5	†10	Hongkong & China, Ltd. ...	10—11	...	...
213,200	Stk.	Aug. 22	6	6	Hornsey Con. 3½ p.c. ...	103—108	...	...
5,600,000	,,	June 6	15	14	Imperial Continental Cap.	185—195	...	187—194½
223,180	,,	Aug. 8	3½	3½	Do. 3½ p.c. Red. Deb.	81—86	...	...
295,242	,,	Aug. 8	8½	8½	Lea Bridge 5 p.c. Ord. ...	142—152	...	...
2,145,907	,,	Aug. 22	6	6	Liverpool 5 p.c. Ord. ...	108—110*b*	−3½	...
245,500	,,	June 20	5	5	Do. 5 p.c. Red. Pref. ...	100—110*b*	...	...
306,083	,,	July 15	4	4	Do. 4 p.c. Deb. ...	85½—90½*b*	...	...
165,786	,,	Sept. 5	10	8	Maidstone 5 p.c. Cap. ...	150—160*	−5	...
56,176	,,	June 20	3	3	Do. 3 p.c. Deb. ...	65—70	...	...
75,000	5	June 20	†10	†10	Malta & Mediterranean ...	7½—8½	...	8¼
392,000	—	Apl. 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb. ...	95—100	...	...
171,978	Stk.	Sept. 5	5	5	M. S. D. Utility "C." Cons.	86—91*	−2	90—90½
718,657	,,	,,	4	4	Do. 4 p.c. Cons. Pref.	80—85*	−2	84—85½
112,126	,,	July 4	4	4	Do. 4 p.c. Deb. ...	87—92	...	...
148,955	,,	,,	5	5	Do. 5 p.c. Deb. ...	105—110	...	...
675,000	,,	21 May '31	16	16	Montevideo, Ltd.	40—60	...	...
2,061,316	,,	Aug. 8	5½	5	Newcastle & Gateshead Con.	19/9—20/9*d*/	−/3	...
682,856	,,	,,	4	4	Do. 4 p.c. Pref. ...	90—91*d*	...	...
691,705	,,	June 20	3½	3½	Do. 3½ p.c. Deb. ...	84—86*d*	...	...
277,285	,,	Apl. 29	5	5	Do. 5 p.c. Deb. '43...	105—110*d*	...	...
274,000	,,	Aug. 8	5	5	Newport (Mon.) 5 p.c. max.	86—88*a*	+1	...
199,940	,,	Aug. 22	7½	7½	North Middlesex 6 p.c. Con.	135—145	...	...
396,160	,,	Aug. 8	5	5	Northampton 5 p.c. max. ...	88—93	...	...
300,000	,,	Apl. 18	9	7	Oriental, Ltd.	85—95	...	...
205,162	,,	June 20	8	8	Plym'th & Stonehouse 5 p.c.	140—150	...	...
504,416	,,	Aug. 22	8	8	Portsm'th Con. Stk. 4 p.c. Std.	137—147	...	142—143
241,446	,,	,,	5	5	Do. 5 p.c. max. ...	88—93	...	...
114,000	,,	Aug. 8	5	5	Preston 5 p.c. Pref.	100—105	...	...
686,312	,,	July 18	4	4	Primitiva 4 p.c. Rd. Db. 1911	75—80	...	76—77
389,813	,,	June 20	4	4	Do. 4 p.c. Cons. Deb.	76—81	...	...
150,000	10	Apl. 4	6	6	San Paulo 6 p.c. Pref. ...	7—7½	...	...
1,786,968	Stk.	Sept. 5	6	6	Sheffield Cons.	108—112*e**	...	...
95,000	,,	July 18	4	4	Do. 4 p.c. Deb.	92—96*e*	+2	...
133,201	,,	Sept. 5	5	8½	Shrewsbury 5 p.c. Ord. ...	108—113*	−2	...
90,000	10	June 6	†5	†5	South African	4—6	...	...
6,709,895	Stk.	Aug. 8	7	5	South Met. Ord.	112—117	...	113—115
1,135,812	,,	,,	6	6	Do. 6 p.c. Irred. Pf.	130—135	...	131—132½
1,895,445	,,	July 4	3	3	Do. 3 p.c. Deb. ...	75—80	...	75—76½
1,000,000	,,	July 18	4	5	Do. 5 p.c. Red. Deb.	108—113	...	...
91,500	,,	Aug. 8	8½	8½	South Shields Con.	130—131*d*	+½	...
1,543,795	,,	Aug. 8	6	6	South Suburban Ord. 5 p.c.	110—115	−2	111½—112½
300,000	,,	,,	5	5	Do. 5 p.c. Pref.	108—113	...	...
668,337	,,	June 20	5	5	Do. 5 p.c. Deb.	116—121	...	117—118½
647,740	,,	Aug. 22	5	5	Southampt'n Ord. 5 p.c. max.	93—98	...	...
121,275	,,	June 20	4	4	Do. 4 p.c. Deb.	88—93	...	...
200,000	,,	June 20	6½	6½	Swansea 6½ p.c. Red. Deb.	105—110	...	107
1,076,490	,,	Aug. 8	6½	6½	Tottenham and District Ord.	127—132	...	...
300,000	,,	,,	5½	5½	Do. 5½ p.c. Pref. ...	114—119	...	116
199,005	,,	June 20	4	4	Do. 4 p.c. Deb. ...	91—96	...	...
85,701	,,	Apl. 4	6	6	Tuscan, Ltd., 6 p.c. Red. Db.	70—75	...	...
346,069	,,	Aug. 22	7	7	Uxbridge, Maidenhead, & Wycombe 5 p.c.	128—133	...	...
88,380	,,	,,	5	5	Do. 5 p.c. Pref. ...	100—105	...	...
1,322,220	,,	July 4	7	7	Wandsworth Consolidated	130—140	−2½	133½—137
971,373	,,	,,	5	5	Do. 5 p.c. Pref.	108—113	...	...
1,167,964	,,	June 20	5	5	Do. 5 p.c. Deb.	115—120	...	116—117⅝
158,400	,,	Aug. 22	6*g*	5	Winchester W. & G. 5p.c. Con.	98—103	...	...

Quotations at:—*a.*—Bristol. *b.*—Liverpool. *c.*—Nottingham. *d.*—Newcastle. *e.*—Sheffield. *f.*—The quotation is per £1 of stock. *g* Paid £3, including 10s. on account of back dividends. * Ex. div. † Paid free of income-tax. ‡ For year.

(This announcement is inserted gratuitously.)

PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun and on occasions—be it admitted—of naughtiness.

Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception.

Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated, and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d. a year to you. Send Peter and his handicapped pals 3d. for every year you've had it. Now, please, in case it slips your memory. Good idea!

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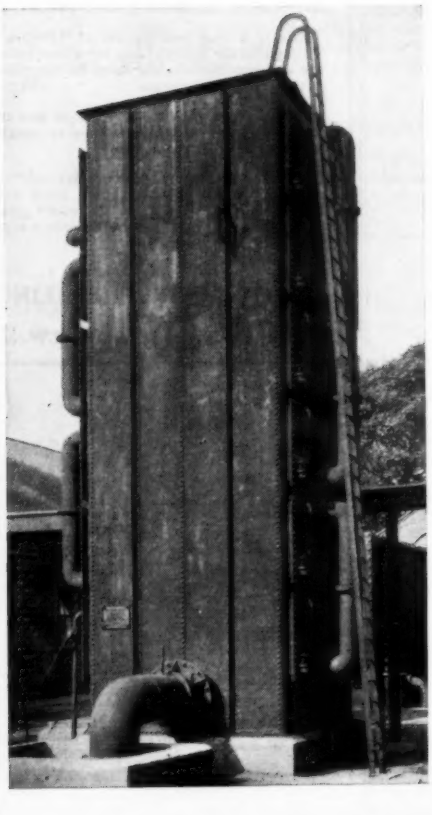

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